THIRD-PARTY EVALUATION OF WORKS DONE UNDER CAMPA IN THE STATE OF HARYANA

SOUTH AND CENTRAL CIRCLE

(2019-20 to 2021-22)








Submitted to

Principal Chief Conservator of Forests &
HoFF, Haryana State Forest Department,
Van Bhawan, Panchkula,
Haryana – 134109

July 2024

Submitted by

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About Us

IORA Ecological Solutions Pvt. Ltd. (IORA) is an environmental advisory group committed towards promoting solutions for conservation and management of natural resources and climate change mitigation and adaptation. With our multi-disciplinary expertise in the domain of environmental finance, policy advisory and scientific research, along with a demonstrated experience in designing and implementation of projects across the world, we have successfully emerged as a notable platform delivering sustainable and scalable environment-related solutions.

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Executive summary

CAMPA is emerging as the largest sustainable source of funding for afforestation activities in the country. There is a growing importance of independent evaluations, to assess what is working and what is not, to be able to improve the program in the future. IORA Ecological Solutions entered into the agreement to take up the evaluation of the CAMPA activities in the State of Haryana. The objective of the evaluation was to assess the status of the CAMPA activities in Haryana, carried out in 2019-20, 2020-2021, and 2021-2022, and also to ascertain the reasons for its success or failure.

Monitoring and evaluation of the forestry interventions need to go beyond the single parameter of survival percentage and delve deeper by asking (1) whether the site selected was suitable for tree planting (2) Whether the species planted are native and suited to the ecosystem (3) Is the growth of the plants adequate? and finally, (4) will they survive beyond the project period and establish into forests? Only when a plantation performs well on all these parameters it can be termed as successful. The objective of this third-party evaluation study was to assess the performance of the CAMPA plantations and non-plantation activities and revolves around three key evaluation questions namely what is the status of survival and growth, what are the best practices and common pitfalls, and the lessons for the next phase. In terms of the evaluation framework, we used the three dimensions of relevance, effectiveness, and sustainability covering the five variables of site suitability, species suitability, growth, survival, and sustainability.

Following the Terms of References (ToR), we sampled 50%, 40%, and 30% area of the total CAMPA sites under each component in each forest division, carried out in 2019-20, 2020-21, and 2021-22 respectively. In each plantation site, 100% of the planted saplings were enumerated. The quantitative method includes the field assessment of height and growth and the actual extent of the plantation. The qualitative method includes the Key Informant Interview (KII) with the Range Officers, and Focus Group Discussion (FGD) with the local villagers whenever required. In the case of SMC and Fencing sites, the length, width, and depth of the structure and extent were physically measured and matched with the measurement book. The expenditures of both structures were also verified.

The afforestation context in the state of Haryana is very different due to its dry climate, topography, unavailability of forestlands, grazing pressure, severe anthropogenic disturbances, and other biotic threats. In the Nuh-Mewat division, due to the presence of the Aravalli hill range, most of the forestlands are subject to dry, rocky terrain and an abundance of invasive species. In Gurugram and Faridabad divisions, the anthropogenic disturbances are very high. In almost every division in Haryana, the afforestation sites are mostly disputed lands, previously encroached on by the local people. Due to the huge livestock population, the grazing pressure is immensely high in most of the sites. Frost and fire also affected the plantation sites in many areas. Hence, due to this diversity of afforestation contexts, it may not be wise to compare the plantation performance across divisions.

- In South Circle, total of 117 sites have been evaluated. For plantation activities (Compensatory Afforestation and Net Present Value) 95 sites have been covered and for non-plantation activities (Fencing, Building and Soil and Moisture Conservation) 22 sites have been covered.
- The Circle has seven plantation models such as CA Tall Plants, CA Tall Plants Alkali, CA Small Plants, NPV Tall Plants, NPV Native, NPV Eco-restoration, and NPV Ridge. The overall survival percentage of plants in this Circle is 60.29%, ranging from 4% to 100%.
- In Central Circle, a total of 152 sites have been evaluated. For plantation activities (Compensatory Afforestation and Net Present Value) 149 sites have been covered and for non-plantation activities (Building) 3 sites have been covered.

- The Circle has four plantation models e.g. CA Tall Plants, NPV Tall Plants, NPV Ridge, and NPV Alkali. The overall survival percentage of plants in this Circle is 63.9% ranging from 5% to 94%.

We came across several good practices and plantation outcomes in the six divisions. In all the divisions, fast-growing native species like Sheesham and Arjun were prioritized for the plantation. These plants also have immense medicinal properties and can withstand moderate forest fire, frost, and waterlogging. Robust growth of Sheesham was observed in most of the sites from 2019-20. Papdi species were also found to be very successful in most of the sites since cattle animals do not prefer this plant for grazing. In Mahendragarh and Rewari divisions, the species and site selection was very good. In all the divisions, the efforts of forest guards and watchers to protect and sustain the plantation sites were commendable.

Both the plantations in the natural landscape and the roadside in some locations needed significant improvements. The common pitfalls identified were lack of any protection measures, selection of unsuitable sites, damage to plants by cattle and wildlife, weed infestation, lack of community participation, and weak record keeping. Selecting sites with high vulnerabilities such as cattle grazing, browsing by wild herbivores, weed infestation, etc. without adequate mitigation and adaptation measures was observed in all the divisions.

We suggest that the threats posed by the drivers of degradation such as grazing, fire, weeds, etc. need to be factored into the plantation plan before afforestation is initiated. The whole range of ecological afforestation approaches needs to be made permissible based on the status of the ecosystem, i.e., whether it is degraded, damaged, or destroyed. In every plantation site, adequate protection measures should be adopted. Instead of the uniform artificial regeneration approach, adapting the plantation models to site-specific locality factors should be encouraged. Exotic plants should be avoided and native species preferred. Non-forest ecosystems such as grasslands that have intrinsic ecosystem values need to be excluded from tree plantations. To prevent fire, grazing, and other anthropogenic disturbances, community involvement before the initiation of the afforestation program is an utmost necessity.

Overall the evaluation study found that the CAMPA plantations are performing satisfactorily. By avoiding the pitfalls, adopting adequate protection measures, scaling up the good practices, and adopting policy changes in the design as discussed above, the next phase of the program can show even better results.

1. Chapter 1: Introduction

There is a global drive to restore degraded ecosystems so that they can again harbour biodiversity, sequester carbon and provide the full range of ecosystem services (IPBES, 2018). One of the approaches in this direction is the forest landscape restoration (FLR) which aims to bring back functionality and productivity to deforested lands while contributing to social and economic wellbeing (McLain et al., 2021). In 2011, as a part of the Global Restoration Initiative (Bonn Challenge), 47 governments committed to bringing 150 million hectares of deforested and degraded land into restoration using the FLR approach by 2020 and 350 million hectares by 2030. The government of India made a Bonn Challenge pledge to bring under restoration 13 million hectares of degraded land by 2020 and an additional 8 million hectares by 2030. Reportedly, it has made a steady progress towards this pledge and by 2018 had already brought an area of 9.8 million hectares under restoration since 2011 (Borah et al., 2018). Primary approach to FLR in India has been afforestation, which is funded through several flagship programmes such as the National Afforestation Programme (NAP), National Mission for a Green India (GIM), National Green Highways Mission, National Mission for Clean Ganga (NMCG), Compensatory Afforestation (CAMPA), Nagar Van Yojana and others. The focus of this report is the plantation and non-plantation activities under Compensatory Afforestation Fund Management and Planning Authority (CAMPA) in the state of Haryana from 2019-20 to 2021-22.

1.1 About the State of Haryana

Haryana is situated in the northern part of India and has a geographical area of 44,212 sq km which constitutes 1.34% of the geographical area of the country. The State lies between latitude 27°39'N to 30°55'N and longitude 74°27'E to 77°36'E. Physiographically Haryana falls in the Indo Gangetic plain although some of the areas fall in Shiwalik hills as well. Climate of the State varies from moist sub- tropical in north bordering Himachal Pradesh to arid in southern part bordering Rajasthan. The State is bordered by Himachal Pradesh and Punjab in the North, Uttarakhand, Uttar Pradesh and Delhi on the East and Rajasthan on the West & South. The average annual rainfall varies from about 200 mm to 1,400 mm and the average annual temperature ranges between 1°C to 45°C. The Yamuna and the Ghaggar are the important rivers of the state.

Haryana is primarily an agricultural State of India and 80% of the total geographical area is under agriculture. As per the Champion & Seth Classification of Forest Types (1968), the forests in Haryana belong to three Forest Type Groups i.e. Tropical Dry Deciduous Forest, Tropical Thorn Forest and Subtropical Pine Forests, which are divided into 10 Forest Types. Over 500 bird species have been recorded in the State, which is almost 40% of total bird species in the country. Although, the maximum portion of the geographical area consists of agricultural fields, over a time, the State has achieved a unique status in the field of agroforestry, which has enabled the forest deficient State to support a large number of wood-based industries based on farm-grown timber. Poplar and Eucalyptus trees are the major agroforestry species, which have become the main resource for improvement of livelihood of farmers in northern and central parts of the State.

Recorded Forest Area (RFA) in the State is 1,559 sq km of which 249 sq km is Reserved Forests, 1,158 sq km is Protected Forests and 152 sq km is Unclassed Forests.

In Haryana, during the period 1st January 2015 to 5th February 2019, a total of 1,529 hectares of forest land was diverted for non-forestry purposes under the Forest Conservation Act, 1980 (MoEF & CC, 2019). Two National Parks, eight Wildlife Sanctuaries and two Conservation Reserves constitute the Protected Area network of the State covering 0.75% of its geographical area.

1.2 Afforestation context in the State of Haryana

Active afforestation in the forest and private lands can positively affect the biodiversity and ecological balance, climate regulation and watershed management of the area. The land-use adjacent to the forestlands is mostly big and smallholder farming and is human dominated which creates severe anthropogenic disturbances. The lack of availability of public and forest lands on-scale in the divisions of Haryana is one of the biggest constraints in the afforestation program. The afforestation context across various divisions is very difficult due to variation in land-uses, topography, severe anthropogenic pressure, lack of forest staffs and, unavailability of funds on time. The Aravalli region in Nuh-Mewat and Mahedragarh Division have dry and rocky soil bed which is not suitable for afforestation initiatives. In Gurugram and Faridabad most of the afforested lands were previously encroached by the local zamindaars. There is a lack of natural forest area to take up plantations and hence most of the activities were carried out as road side plantation. Due to the high livestock population, the grazing pressure in every division is immense. Hence, it may not be wise to compare the activities across divisions and with other states as the restoration context is very different.

1.3 About CAMPA

With a cover of 23% of Geographical area of the country, forest in India comprise of a number of diverse forest types and reserved areas designated as National Parks and Wildlife Sanctuaries. In India, forest meet the livelihood needs of people living in and adjoining the forests in about 1, 73,000 villages. Forests also act as carbon sinks and regulators of water regime.

Many development and industrial projects such as erection of dams, mining, and construction of industries or roads require diversion of forest land. Any project proponent, government or private must apply for forest clearance from Ministry of Environment and Forests (MoEF), before the conversion of land take place. This proposal is to be submitted through the concerned forest department of the state government. If clearance is given, then compensation for the lost forest land is also to be decided by the ministry and the regulators.

Due to certain discrepancies in the implementation of compensatory afforestation, some NGOs had approached The Hon'ble Supreme Court for relief. The Hon'ble Supreme Court on 10th July, 2009 issued orders that there will be a Compensatory Afforestation Fund Management and Planning Authority (CAMPA) as National Advisory Council under the chairmanship of the Union Minister of Environment & Forests for monitoring, technical assistance and evaluation of compensatory afforestation activities.

1.4 Objectives of CAMPA

Compensatory Afforestation Fund Management and Planning Authority (CAMPA) are meant to promote afforestation and regeneration activities as a way of compensating for forest land diverted to non-forest uses. National CAMPA Advisory Council has been established as per orders of The Hon'ble Supreme Court with the following mandate:

- Lay down broad guidelines for State CAMPA.
- Facilitate scientific, technological and other assistance that may be required by State CAMPA.
- Make recommendations to State CAMPA based on a review of their plans and programmes.
- Provide a mechanism to State CAMPA to resolve issues of an inter-state or Centre-State character.

1.5 Organization of the report

The report is the final part of the evaluation and monitoring of CAMPA activities in Haryana carried out in the year 2019-20, 2020-21 and 2021-22. This final report is the compiled version of the activities carried out in 5 forest divisions in South territorial circle.

In the report, the primary findings of the evaluation work are focused into three parameters:

a) Relevance (Species and site suitability)

b) Effectiveness (Survival, growth and extent)

c) Sustainability (Monitoring, protection and maintenance)

For each circles, division-wise good practices and pitfalls along with geo-tagged photos will be provided. For each pitfall, recommendations are provided.

2. Chapter 2: Objective

Evaluation is a rigorous and independent assessment of project activities to determine the extent to which they are achieving stated objectives. The key distinction between evaluation and monitoring is that evaluations are done independently and are also more rigorous in their procedures, design and methodology, and generally involve more extensive analysis. Evaluation of plantations needs to cover aspects of site suitability, species selection, survival, growth and future sustainability.

The objective of an evaluation is to provide information that can help inform decisions, improve performance and achieve planned results. The objective of the present evaluation study is to address the following key points namely:

1. Current status, survival and growth of the activities
2. Extent of the activities
3. Best practices and common pitfalls
4. Provide viable recommendations

We assessed not only the outputs and outcomes of the initiative but also critically analyzed the programme design, decision making and implementation process. So, for plantations that are excellent, the evaluation probed the reasons for the success, and for plantations that performed poorly, the reasons for the failure were noted. So that in the phase, corrective action can be taken to upscale the success stories and prevent the failures from repeating.

3. Chapter 3: Programme Component

3.1 Plantation Activity

3.1.1 Compensatory Afforestation (CA)

Compensatory afforestation (CA) is one of the most important requirement/condition for prior approval of the Central Government for diversion of forest land for non-forest purposes and the purpose of compensatory afforestation (CA) is to compensate the loss of 'land by land' and loss of 'trees by trees' (Forest (Conservation) Act, 1980).

Any proposal submitted by the State/UT Government seeking prior approval of Central Government under the FCA shall have a comprehensive scheme for compensatory afforestation, duly approved by the competent authority of the concerned State/UT administration.

Land for CA:

(i) Normally, CA is to be raised on suitable non-forest land, equivalent to the area proposed for diversion, at the cost to be paid by the User Agency.

(ii) As far as possible, the non-forest land for CA is to be identified as contiguous to or in the proximity of a Reserve/Protected Forest to enable the Forest Department to effectively manage the newly planted area.

(iii) Where non-forest land is available but lesser in the extent to the forest area being diverted, CA could be carried out over degraded forest twice in the extent of the area being diverted or the difference between the forest land being diverted and the available non-forest land, as the case may be. The non-availability of suitable non-forest land for CA in the State / Union Territory would be accepted by the Central Government only on the basis of a Certificate of the Chief Secretary of the State/Union Territory Government to that effect in respect of States/UTs having forest area more than 33% of the geographical area in the prescribed format.

(iv) In case, non-forest land for CA is not available in the same district, it should be identified anywhere else in the concerned/State/Union Territory near to the site of diversion as far as possible, so as to minimize adverse impact on the micro-ecology of the area.

(v) In exceptional cases where non-forest land for CA is not available in the same State/UT in which the diversion of forest land is proposed, land for CA can be identified in any other State/UTs, preferably in neighboring State/UTs. The corresponding amount for carrying out CA shall be deposited in the CAMPA account of the State/UT in which CA is proposed.

The types of CA plantation activities undertaken by the state is mentioned below

1. CA Tall Plant (CA TP)

Plantation of tall plants (6-8 ft.) with a plantation density of 1000 saplings per hectare.

2. CA Small Plant (CA SP)

Plantation of small plants (1-2 ft.), with a plantation density of 1000 saplings per hectare.

3. CA Trench cum Pit Method

Plantation of tall plants (6-7 ft.) with a plantation density of 1000 saplings per hectare. Trenches are dug next to the planted saplings.

3.1.2 Net Present Value (NPV)

It is a mandatory one-time payment that a user has to make for diverting forestland for non-forest use, under the Forest (Conservation) Act, 1980. As per the CAF Act 2016, the money

received towards net present value and penal net present value shall be used for artificial regeneration (plantation), assisted natural regeneration, forest management, forest protection, forest and wildlife-related infrastructure development, wildlife protection and management, supply of wood and other forest produce saving devices and other allied activities in the manner as may be prescribed.

The types of NPV activities undertaken by the state are:

1. NPV Tall Plant

This plantation model consists of tall plants (6-8 ft.) and a density of 250 saplings per RKM (Running Kilometers).

2. NPV Ridge

In this plantation model tall plants (6-8 ft.) were planted on ridges of 8-10 m to reclaim waterlogged areas or retain the moisture in dry areas. Usually, 500 saplings per RKM are planted in this model.

3. NPV Native

It is a plantation model with tall plants (5-8 ft.) where 500 saplings are planted per RKM. In this model, only native species of the area are chosen.

4. NPV Eco-restoration

It is a plantation model where small plants (1-2 ft.) with a sapling density of 200 per RKM. In this case, plantations are usually protected by stone wall.

5. NPV Alkali

In this plantation model, saplings were planted on alkaline soil to reclaim and restore the land. Tall plants (5-6 ft.) and small plants (1-2 ft.) are planted at a density of 1000 saplings per hectare.

3.2 Non-plantation Activity

3.2.1 Fencing

Fencing is the principal protection measure for a plantation. Two kinds of fencing are used in the forest sector, i.e. Barbed wire Fencing and Chain Link Fencing.

3.2.2 Soil and Moisture Conservation (SMC) Works

SMC works are usually done to capture and retain the moisture in the soil in places with water scarcity. There are various kinds of effective SMC works, e.g. Soak pits, Check Dams, ponds, crate wire structures, Contour trenches, percolation ponds, reinforced cement concrete structures, stone studs etc.

3.2.3 Buildings

These activities include the construction of residential and official buildings for forest range officers, frontline staff, etc. deployed for the protection of forest and wildlife.

3.3 Development and Wildlife Wing

3.3.1 Wildlife Wing

Wildlife Wing undertakes activities like wildlife management and conservation, establishment, expansion and up-gradation of wildlife facilities, purchase of wildlife and rescue equipment, construction of boundary walls, extension of protection center, construction of office, residences for staff, shelter homes, habitat improvement, etc.

3.3.2 Development Wing

Activities like maintenance of research plots, creation of germplasm, construction of underground water storage, construction of RO, mist chamber, etc. were undertaken by the Research, Seed and Training Divisions of the state.

Publicity and Training Circle carries out activities like training camps for stakeholders, capacity-building workshops, development of publicity material, excursions for the researchers, exposure and education visits for school children, video documentation etc.

4. Chapter 4: Programme Implementation Agencies and Hierarchy

4.1 State CAMPA

The Hon'ble Supreme Court also approved the guidelines prepared by the MoEF for utilizing CAMPA funds by an agency to be constituted in the states and to be known as The State CAMPA.

Some of the key points in the guidelines are:

- The State CAMPA would presently receive funds collected from user agencies towards compensatory afforestation, additional compensatory afforestation, penal compensatory afforestation, Net Present Value (NPV) and all other amounts recovered from such agencies under the Forest (Conservation) Act, 1980 and presently lying with the Adhoc CAMPA.
    - The State CAMPA would administer the amount received from the Adhoc CAMPA and utilize the funds collected for undertaking compensatory afforestation, assisted natural regeneration, conservation and protection of forests, infrastructure development, wildlife conservation and protection and other related activities and for matters connected therewith or incidental thereto.
    - State CAMPA would provide an integrated framework for utilizing multiple sources of funding and activities relating to protection and management of forests and wildlife. Its prime task would be regenerating natural forests and building up the institution engaged in this work in the State Forest Department including training of the forest officials of various levels with an emphasis on training of the staff at cutting edge level (forest range level). In short, the department would be modernized to protect and regenerate the forests and wildlife habitat.

The guidelines also talk about establishment of an independent system for concurrent monitoring and evaluation of the works implemented in the States utilizing the funds available.

In sum, the prime task of State CAMPA would be regenerating natural forests and building up the institution engaged in this task in the State Forest Department.

4.2 CAMPA in Haryana

Prior to the enactment of Compensatory Afforestation Fund Act, 2016, in compliance of the directions of the Supreme Court and guidelines issued by the MoEF & CC, New Delhi on 2nd July 2009, Haryana Government had constituted the State CAMPA vide notification no. 5330-Ft-4-09/511 dated 08.01.2010. The State Authority, CAMPA was comprised of

- the Governing Body chaired by Hon'ble Chief Minister, Haryana,
- the Steering Committee chaired by the Chief Secretary to the Government of Haryana, and
- the Executive Committee chaired by the Principal Chief Conservator of Forests (HoFF).
- With the enactment of the Compensatory Afforestation Fund Act, 2016 and notification of Compensatory Afforestation Fund Rules, 2018, the "Haryana State Compensatory Afforestation Fund Management and Planning Authority (State Authority) has been reconstituted in accordance with the provision of Section-10 of Compensatory Afforestation Fund Act, 2016 vide notification dated 22.11.2018. The reconstituted State Authority has a Governing Body headed by the Hon'ble Chief Minister, of Haryana, a Steering Committee headed by the Chief Secretary to the Government of Haryana and an

Executive Committee headed by the Principal Chief Conservator of Forests, (Head of the Forest Force).

4.3 Haryana State Forest Department

The Forest Department of Haryana is the implementing agency for the CAMPA scheme. The forest depart of Haryana is consist of 22 forest divisions, falling under 4 territorial circles, Wildlife Wing, the Research and Development Division, and the Publicity and Training Circle.

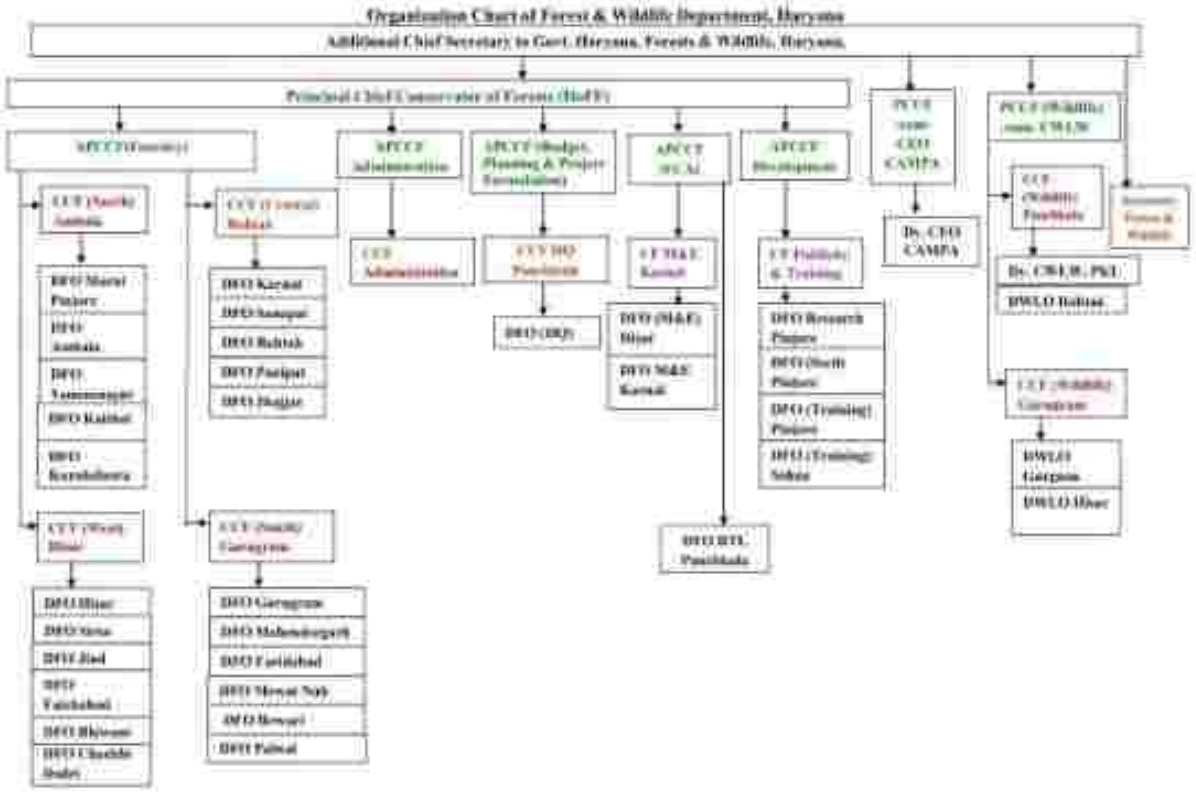

Figure 4.1: Organization chart of Forest & Wildlife Department, Haryana

5. Chapter 5: Methodology

5.1 Evaluation framework

The IFAD evaluation framework elucidates five dimensions that need to be covered namely relevance, effectiveness, impact, efficiency and sustainability (IFAD evaluation manual 2009).

Relevance concerns the extent to which a development initiative and its intended outputs or outcomes are consistent with the needs of the environment and the intended beneficiaries. Relevance also considers the extent to which the plantation activity is suited to the environment and the intended beneficiaries. In applying the criterion of relevance, the evaluation explored the extent to which the planning, design and implementation took into account the local context in terms of the needs of the local community and the environment. Two variables namely site suitability and species selection were measured.

- Effectiveness is a measure of the extent to which the initiative's intended results have been achieved. Evaluating effectiveness involves an assessment of cause and effect that is, attributing observed changes to project activities and outputs. While assessing the effectiveness of plantations, the two variables - growth and survival were measured.
- Impact measures changes in human development and people's well-being that are brought about by development initiatives, directly or indirectly. At times, evaluating impact faces challenges: Confirming whether benefits to beneficiaries can be directly attributed to the intervention can be difficult, especially since there are several ongoing interventions often with overlapping objectives. As the plantations are only a few years old, it is too early to measure their impact either on local livelihoods or the environment. Efficiency includes a measure of how economic inputs (funds, expertise, time, etc.) are converted into results. An analysis of budget use and compliance is also important to assess the efficiency dimension. Measuring efficiency will need an assessment of financial aspects and would take the form of a financial audit and hence was not attempted.
- Sustainability is the likely continuation of net benefits from an intervention beyond the phase of funding support. It includes an assessment of the likelihood that the results will be resilient to risks beyond the project's life. While assessing sustainability the prospects of future survival of the plants was assessed based on risks like droughts, grazing, fire etc.

Hence, of these five evaluation criteria, the present evaluation covered the three dimensions of relevance, effectiveness and sustainability by measuring the five variables namely site suitability, species selection, growth, survival and sustainability.

5.2 Approach

IORA Ecological Solutions entered into agreement with the Haryana State Forest Department to execute the Third Party Evaluation and monitoring of CAMPA activities carried out in the year of 2019-20, 2020-21 and 2021-22 on 28th November, 2022.

The framework for this evaluation focused on three key parameters namely - relevance (site and species suitability), effectiveness (survival, growth and area coverage) and sustainability (maintenance, protection and monitoring. Extensive fieldwork have been carried out for primary data collection using both quantitative and qualitative tools.

Quantitative tools were used to assess the survival and health of the plantation, geographical features, and actual area extent. Qualitative tools were used to understand the hurdles faced by the forest department in various phases of the plantation, disturbance regime, pitfalls, good practices etc. Two PRA tools, e.g. Key Informant Interview (KII) and Focus Group Discussion (FGD) were used to get the perception of both the stakeholders and the implementing authority. Departmental APO, plantation journal, and measurement book were used as secondary information to validate the primary data. Photographic evidence, GPS tracks along

the plantation boundaries, and waypoints have been generated through the field visits.

5.3 Sampling strategy

The consolidated list of work carried out under the CAMPA scheme in 2019-20, 2020-21 and 2021-22 was collected from the Haryana CAMPA head office, in Chandigarh.

As required in the Terms of References, the sampling intensity was 50%, 40% and 30% of the total area of plantations under each component in each division for 2019-20, 2020-21 and 2021-22, respectively. In the case of the non-plantation activities, the same sampling strategy was adopted.

Within a plantation site, 100% enumeration of the planted saplings was carried out to ensure the proper output of the evaluation.

Table 5.1: Methodology adopted for data collection

Method	Description	Usage
Primary Data		
Field Enumeration	Field observation in the sites by using GPS. Within a site, 100% enumeration of the planted saplings was done.	Assess the effectiveness of the plantation by measuring the height, survival and the area extent
Key Informant Interview	Qualitative in-depth interviews with those who have first- hand knowledge of the initiative operations and context.	Identify the difficulties faced in planning, implementation and monitoring phases to figure out how the effectiveness of the plantation can be enhanced.
Focus Group Discussions	A small group (5-10 people) discussion on a limited set of topics to explore in-depth stakeholder opinions and perceptions of the initiative and its impact. Semi-structured questionnaires were used to ensure a standardized approach to obtain information from the group concerning the inputs, outputs and contextual factors of the initiative.	Assess the extent of active community participation in these type of projects and the impacts of the communities from different socio-economic background on various CAMPA initiatives.
Photos with good resolution	Good resolution, geotagged photos were taken to identify the good practices and pitfalls of the plantation. Google Earth historical imagery system was used	The photos will reflect the current situation of the plantation.
Data collection	The data entry was done by using the Kobo toolbox system, which is much more convenient.	Kobo app was used in the field for faster data entry by using mobile.
Secondary Data		

State Level	Details of CAMPA projects including financial (allocations, sanctions, expenditure), physical (planning process, approved projects, various government directives etc.) and monitoring (internal monitoring reports, government directives etc.)	To assess the physical and financial allocations, targets and expenditure of the total initiative.
Circle/Division Level	Project proposal, estimate, sanction order, work commencement order, plantation journal, compartment history, working plan prescriptions for the compartment, muster rolls, expenditure vouchers, completion reports, process photographs, monitoring reports, GPS points.	To assess the physical and financial targets of the projects, planning and implementation of the individual projects, inputs, process and outputs of these projects.

5.4 Quantitative data collection

5.4.1 Assessing the extent of the plantation

Within a site, the extent/ boundary of the plantation was measured by using GPS (Locus Map). Tracks were made using GPS in each plantation site for further verification. The track was then saved and extracted as a KML file. Measuring the area coverage of plantation projects in forest areas can prove to be difficult using conventional tools, especially for large plantations. In these cases, GPS receivers were used and waypoints were obtained by traversing the perimeter of the plantation. These points were projected on Google Earth Pro which supports measuring area and perimeter with a polygon tool which helped to assess the accuracy of the plantation area.

5.4.2 Enumeration of the planted materials

All the pits were counted in a plantation to assess the survival rate of the plantation. Species wise height and collar girth/ GBH were recorded as the key growth parameters. The health of the saplings (wilting/ browsed/ wounded/ stressed/ pathogen attack etc.) was also recorded by ocular observation.

Geo-tagged photos were taken at every plantation and non-plantation sites.

5.4.3 Physical verification of non-plantation sites

In case of a non-plantation site, the width, depth and length of the structure were physically measured and then matched with the APO data. Financial verification was also done by matching the amount of actual expenditure with the state APO. Geotagged photos were taken from every angle to depict the exact condition of the structure.

The data (both plantation and non-plantation) were collected by using Kobo collect app. It is an open data collection toolbox, which was customized by IORA especially to ease the data collection in the field. The datasheets were then extracted from Kobo as excel files.

Figure 5.1: Field enumeration at a plantation site, Rewari Division

Figure 5.2: Physical verification of SMC structure (non-plantation) in Palwal division

5.5 Qualitative data collection

The objective of the qualitative data collection is to analyze the effectiveness of the four stages of the plantation activity i.e. planning, implementation, maintenance and protection by obtaining feedback from the local community and the technical staff. PRA tools were used to

interview the local community and the technical staff. A semi-structured questionnaire was designed to conduct a Focus Group Discussion (FGD) with the local community and a Key Informant Interview (KII) of the technical staff, preferably the Range Officer. These PRA tools had both open-ended and closed questions and provided valuable insights on the present status of the plantation, and also how to improve the effectiveness of future plantations.

Figure 5.3. Focus group discussion with the local people at Golwa site, Mahendragarh division

Figure 5.4. Key information interview with the Range Officer at Faridabad division

5.6 Criteria for grading the plantation sites

It is useful to have ranking/scales to evaluate the plantation projects. However, this is not easy since the site parameters, species and inputs provided will vary from plantation to plantation and it may not be appropriate to rank such heterogeneous plantation projects using a common scale.

The common grading criteria for a plantation site are:

- Survival rate
- Species composition as per the APO
- Growth of the planted species
- Extent of the plantation
- Site suitability
- Species suitability
- Protection measure
- Monitoring/ Watch and ward
- Plantation journal/ measurement book
- Plantation map and KML files
- Presence of major invasive species (*Prosopis juliflora* and *Lantana camara*)
- Weeding in site
- Hoeing on sites

For raising of plantations, scoring of each sample was carried out on a scale of 0 to 300. Scoring for evaluating the field plantation samples was based on survival percentage. Sample plantation plots with the survival of more than 91% scored 300 points, 71% to 90% = 240 points, 51% to 70%= 200 points, 31% to 50% = 180 points and for the survival of plantations, lesser than 30% = 100 points were given.

5.7 Criteria for grading non-plantation sites

5.7.1 Fencing:

- Fencing type
- Working status
- Activity status
- Serving the purpose intended
- Expenditure as per the APO
- Site suitability
- Measurement book

5.7.2 Soil and Moisture Conservation (SMC)

- SMC type
- Working status
- Site suitability
- Measurement as per the APO
- Measurement book
- Fulfilling design specifications

5.7.3 Buildings

- Location
- Building status
- Serving intended purpose
- Expenditure as per the APO
- Measurement book
- Dampness and leaks on the walls
- Structural quality and cracks
- Site on e-greenwatch

5.8 Data Analysis

The data (both plantation and non-plantation) were collected by using the Kobo collect app. It is an open data collection toolbox, which was customized by IORA especially to ease the data collection in the field. The datasheets were then extracted from Kobo as Excel files.

Good practices and pitfalls in each site were obtained by using PRA tools and ocular observation and mentioned in the report. Based on the pitfalls in each plantation site, viable recommendations were made.

Good plantation sites were highlighted as success stories, where the uniqueness of the sites was reported and the changes in the landscape over the years due to the plantation were observed by using Google Earth Historical Imagery.

5.9 Limitations

5.9.1 Capturing variability across sites

Haryana is a state with wide varieties of ecological parameters. The geology, rainfall, soil, topography, vegetation types and many other parameters change significantly across the length and breadth of the state. The key drivers of degradations were also found to be different in each division. It was very challenging to capture the variability across various sites in different divisions.

5.9.2 Accessibility in the sites

In most areas of the South Circle, the abundance of *Prosopis juliflora* makes the site almost inaccessible. Due to this invasive species, most planted individuals were stunted, thus very hard to identify and measure. The same situation was faced in Central Circle, where the sites were almost inaccessible due to the presence of *Sachharum spontaneum*. In the Mahendragarh and Nuh-Mewat divisions, some sites were inaccessible due to presence of illegal mining and hostile local communities.

Nevertheless, every site was enumerated properly despite the presence of these problems.

5.9.3 Enumeration in larger sites

As required in the Terms of Reference (ToR), we conducted 100% enumeration in all the sites. Some of the sites were spread across vast areas (30-50 ha/ 30-60 RKM). In those sites, plantation enumeration was extremely tedious and challenging, due to the large area and huge number of planted species.

6. Chapter 6: South Circle

The South Circle consists of six divisions, Rewari, Mahendragarh, Gurugram, Nuh-Mewat, Palwal and Faridabad. Every division is unique in terms of the terrain, local vegetation, drivers of degradation, and results produced. The findings are categorized into three dimensions: Relevance, Effectiveness and Sustainability by measuring five principal variables namely site suitability, species selection, growth, survival and sustainability.

Table 6.1: Plantation target and achievement under CATP and NPVTP for 2019-20

Divisions	CATP			NPVTP		
	Target (Ha)	Achieved (Ha)	Plants	Target (RKM)	Achieved (RKM)	Plants
Gurugram	15.805	10.846	10846	11	11	2750
Faridabad	244.5	25.32	25137	30	30	7500
Rewari	3.87	35.466	8867	30	30	7500
Mahendragarh	0.474	0.474	474	40	40	10000
Palwal	0.025	0.025	25	30	30	7500
Nuh-Mewat	5.93	5.11	5117	30	30	7500

Table 6.2: Plantation target and achievement under CATP and CASP/TRENCH CUM PIT for 2020-21

Divisions	CATP			CASP/TRENCH CUM PIT		
	Target (Ha)	Achieved (Ha)	Plants	Target (Ha)	Achieved (Ha)	Plants
Gurugram	35.02	35.02	50936	0	0	0
Faridabad	2.28	2.28	2278	233.4	120	96000
Rewari	11.667	23.228	23228	0	0	0
Mahendragarh	1.835	1.835	1835	31.14	31.14	31140
Palwal	0	0	0	0	0	0
Nuh-Mewat	29.438	29.2821	29438	15	15	10000

Table 6.3: Plantation target and achievement under NPVTP and NPV NATIVE for 2020-21

Divisions	NPVTP			NPV NATIVE		
	Target (RKM)	Achieved (RKM)	Plants	Target (RKM)	Achieved (RKM)	Plants

Gurugram	100	100	25000	0	0	0
Faridabad	50	50	12500	0	0	0
Rewari	100	100	25000	0	0	0
Mahendragarh	100	100	25000	0	0	0
Palwal	50	50	12500	0	0	0
Nuh-Mewat	100	100	25000	50	50	25000

Table 6.4: Plantation target and achievement under NPV RIDGE and NPV ECO-RESTORATION

Divisions	NPV RIDGE			NPV ECO-RESTORATION		
	Target (RKM)	Achieved (RKM)	Plants	Target (RKM)	Achieved (RKM)	Plants
Gurugram	0	0	0	0	0	0
Faridabad	0	0	0	0	0	0
Rewari	0	0	0	0	0	0
Mahendragarh	0	0	0	60	60	12000
Palwal	33	33	10890	80	80	16000
Nuh-Mewat	0	0	0	0	0	0

Table 6.5: Plantation target and achievement under CATP and NPVTP for 2021-22

Divisions	CATP			NPVTP		
	Target (Ha)	Achieved (Ha)	Plants	Target (RKM)	Achieved (RKM)	Plants
Gurugram	85.616	78.84	88710	0	0	0
Faridabad	117.1671	85.509	85509	100	100	25000
Rewari	72.329	72.33	72329	200	200	50000
Mahendragarh	54.587	51.699	51699	0	0	0
Palwal	9.393	9.827	9827	200	200	50000
Nuh-Mewat	84.305	84.305	84305	200	200	50000

Table 6.6: Plantation target and achievement under NPV NATIVE and NPV ECO-RESTORATION

Divisions	NPV NATIVE			NPV ECORESTORATION		
	Target (RKM)	Achieved (RKM)	Plants	Target (RKM)	Achieved (RKM)	Plants
Gurugram	0	0	0	20		4000
Faridabad	0	0	0	0		0
Rewari	0	0	0	0		0
Mahendragarh	0	0	0	0		0
Palwal	0	0	0	0		0
Nuh-Mewat	85	42500		110		22000

6.1 GURUGRAM DIVISION

Table 6.7: CA (Compensatory Afforestation) plantation activities evaluated in the Gurugram division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
					2019-20							April, 2023
2019-2020	Sohna	Gairatpur Bas	CA-TP	Gairatpur Bas Sec 4 & 5 Aravali	10.846 ha	10.846 ha	10646	5640	2933	52	3.9	
					2020-21							
2020-2021	Gurugram	Gurugram	CA TP	Ghata section 4 & 5	10 Ha	10 Ha	6500	6500	3705	57	6.1	
2020-2021	Haily mandi	Hailymandi	CA-TP Alkali	Sarbasirpur RF	13.84 Ha	13.84 Ha	900	900	585	65	9.6	
2020-2021	Haily mandi	Hailymandi	CA-TP	Jatauli Bundh RDO-Tail (L&R)	2 Ha	2 Ha	1300	1300	520	40	5.3	
2020-2021	Sohna	Sohna	CA-TP	Nuh Sub Branch RD 10 to 20	2.36 Ha	2.36 Ha	1500	1500	900	60	3.6	
2020-2021	Sohna	Sohna	CA-TP	Gurugram canal RD 51289	6 Ha	6 Ha	2400	2400	1920	80	7	
2020-2021	Sohna	Sohna	CA-TP	Harchandpur distributory	4 Ha	4 Ha	2800	2800	1960	70	9.5	
					2021-22							
2021-2022	Gurugram	Gurugram	CA-SP	Ghata section 4 & 5	10 Ha	10 Ha	4500	4500	2025	45	1.6	
2021-2022	Gurugram	Gurugram	CA-SP	Behrampur section 4&5	10 Ha	10 Ha	7400	7400	5476	74	1.9	
2021-2022	Haily mandi	Hailymandi	CA-TP	Garhi Harsaru Farrukhnagar Rly. Line	5.67 Ha	5.67 Ha	1021	1021	184	18	3.4	

Table 6.6: NPV (Net Present Value) plantation activities evaluated in the Gurugram division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
				2019-20								April, 2023
2019-2020	Gurugram	Gurugram	NPV-TP	Gairatpurbas/Sakatpur section 4&5	11 RKM	11 RKM	2750	2750	935	34	4.6	
				2020-21								
2020-2021	Gurugram	Manesar	NPV-TP	Sikhopur section 4 & 5	16 RKM	16 RKM	2400	2400	1560	65	3.4	
2020-2021	Gurugram	Manesar	NPV-TP	NSG Manesar	14 RKM	14 RKM	2800	2800	1820	65	5.3	
2020-2021	Hailymandi	Hailymandi	NPV-TP	Patuda minor RD 42.890 to 69.100 L	10.5 RKM	10.5 RKM	1500	1500	960	64	8.9	
				2021-22								
2021-2022	Gurugram	Gurugram	Ecorestoration model III	Bandhwari section 4&5	20 Ha	20 Ha	2000	2000	1000	50	1.5	

6.1.1 Relevance

6.1.1.1 Site Suitability

- Dry and shallow soil affects the plantation

Plantation sites that are part of the Aravalli Mountain range are very dry by nature and thus growth of plantations in these sites is very slow (Figure 6.1) although the survival percentage of a few of these plantation sites was quite satisfactory. Furthermore, these plantation sites have shallow soil which makes the conditions even more hostile to the plants. The remaining sites have relatively better moisture content and other soil conditions which have resulted better growth and survival rate in these sites.

Figure 6.1: Saplings planted along the Aravalli range of the Gurugram division

- Sites along the canals and agricultural fields showed good growth

The plantation sites along the canals and agricultural fields exhibit good growth (Figure 6.2) due to availability of water and the fertilizers that seep in from the adjacent agricultural fields.

Figure 6.2: Planted saplings showed great growth along the canals and agricultural fields

Apart from the abovementioned points, the other factors which affected the survival and growth of the plantations are:

- Impact of Frost

The frost was seen to have affected the growth and survival of *Holoptelea integrifolia* in some plantation sites (Figure 6.3). In these sites, saplings were seen to have suffered back and thus their survival and growth were affected to a large extent. Measures should be taken to cover such frost-prone plant species to ensure proper survival and growth of plants.

Figure 6.3: The effect of frost causing dieback of Holoptelea integrifolia

- Abundance of Invasive species

The invasive species such as Parthenium hysterophorus, Prosopis juliflora and Argemone mexicana were found abundantly across all the plantation sites (Figure 6.4). The invasive

plants will have inflicted detrimental impact on the survival and growth of the saplings due to their better competitive ability and allelopathic chemicals released into the soil. Therefore, proper management of invasive species is needed to ensure better survival and growth of plantations.

Figure 6.4: Invasion by Prosopis juliflora and Parthenium hysterophorus

- Anthropogenic disturbance

Local communities are, to some extent, also affecting the plantation in many different ways. The plantation site, Ghata sections 4 & 5 was damaged at some points by local people due dispute between the forest department and local people (Figure 6.5). Garbage dumping by local people in the plantation sites is another driving cause affecting the plantation. The involvement of local people through awareness about the importance of plants should be encouraged to ensure the proper survival and growth of plantations.

Figure 6.5: Garbage dumping and destroyed saplings in plantation sites

❖ Impact of cattle grazing

Grazing by cattle is a common practice reported across all the plantation sites in the Gurugram division resulting in reduced survival and growth of saplings in these plantations (Figure 6.6). The Majority of these grazing cattle included Goats, and feral cows, and a few were domestic cows belonging to the local villagers. The drivers of degradation should be identified and minimized before the plantation initiative begins.

6.1.1.2 Species Suitability

Figure 6.6: Cattle grazing on plantation site in Gurugram division

6.1.1.3 Species selection

The species selection has been made based on the conditions of the plantation site. Due to dry conditions and rocky surfaces prevailing in the Aravalli region, drought-resistant species such as Reonj (*Acacia leucophloea*) and Papri (*Holoptelea integrifolia*) were preferred for plantation (Figure 6.7). But extremely unfavourable edaphic conditions (rocky soil bed) prevent the roots of the saplings from growing resulting in stunted growth and even death of the saplings.

Figure 6.7: Drought-resistant species such as Acacia leucophloa and Holoptelea integrifolia planted in dry areas

In the plantations along the canals and the road, tall saplings of fast-growing species like Neem, Sheesham, Balamkheera, Bakain etc. were planted (Figure 6.8). Most of these trees have medicinal properties and will act as shade trees within 5 years of plantations, due to their fast-growing nature.

Figure 6.8: Saplings planted along agricultural fields and Canals

The plantation sites with alkaline soils had species like Arjun (*Terminalia arjuna*), Jamun (*Syzygium cumini*), Sheesham (*Dalbergia sissoo*), Papri (*Holoptelea integrifolia*) and Balamkheera (*Kigelia pinnata*) (Figure 6.9).

Figure 6.9: Saplings planted in Alkaline soils

Table 6.9: Planted species found in the plantations of Gurugram division

S.no	Planted species	
	Local Name	Botanical Name
1	Papdi	*Holoptelea integrifolia*
2	Reunjh	*Acacia leucophloea*
3	Bottle brush	*Callistemon*
4	Balamkheera	*Kigelia pinnata*
5	Sheesham	*Dalbergia sisoo*
6	Neem	*Azadirachta indica*
7	Gulmohor	*Delonix regia*
8	Lasoda	*Cordia myxa*
9	Khair	*Dichrostachys cinerea*
10	Bakain	*Melia azadarach*
11	Siris	*Albizia lebback*
8	Pilkhan	*Ficus virens*
13	Peepal	*Ficus religiosa*
14	Arjun	*Terminalia arjuna*

6.1.2. Effectiveness

6.1.2.1. Survival

ThThe average survival rate of Plantation was recorded as 56% and it varied from as low as 18% (Gairatpurbas/Sakatpur section 4&5) to as high as 80% (NSG). Among the plantation years, the highest survival percentage was observed for the plantations established during the year 2020-21, followed by the plantations established during the years 2021-22 and 2019-20 respectively (Table 6.10).

Table 6.10: Year-wise average survival rate and average height

S. NO.	Year	Survival %	Average height (ft)
1	2019-2020	28	4.0
2	2020-2021	63	8.6
3	2021-2022	47	1.9

6.1.2.2 Growth of Plantations

Pipal (*Ficus religiosa*), Gulmohar (*Delonix regia*) and Neem (*Azadirachta indica*) have attained the tallest height in the 2019-20, 2020-21 and 2021-22, year plantations respectively (Table 6.11, Figure 6.10). However, Gulmohor is considered a tree with weak stem and is not advised to plant roadside.

Table 6.11: Year-wise growth of different plant species

S.no	Planted species		Plantation year		
	Local Name	Botanical Name	2019-20	2020-21	2021-22
1	Papdi	Holoptelea integrifolia	4.5	4.8	2.2
2	Reunjh	Acacia leucophloea	3.1	0	1.6
3	Bottle brush	Calistemon	4.2	0	0
4	Balamkheera	Kigelia pinnata	0	8	2.2
5	Sheesham	Dalbergia sisoo	0	6.6	0
6	Neem	Azadirachta indica	0	9.2	3.1
7	Gulmohor	Delonix regia	0	15	0
8	Lasoda	Cordia myxa	0	8.6	0
9	Khair	Dichrostachys cinerea	0	7.1	1.5
10	Bakain	Melia azadarach	0	10.9	0
11	Siris	Albizia lebback	0	8.2	0
8	Pilkhan	Ficus virens	4.2	0	0
13	Peepal	Ficus religiosa	4.8	0	0
14	Arjun	Terminalia arjuna	0	7.7	0

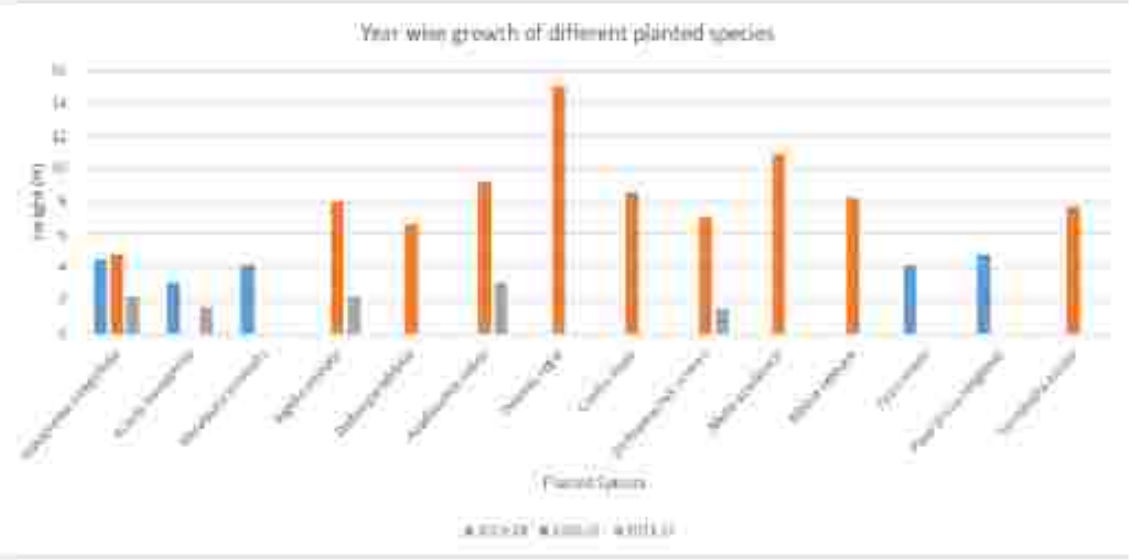

Figure 6.10: Year-wise growth pattern of different plant species

6.1.3. Sustainability

6.1.3.1. Protection

Most of the plantation sites in the Gurugram division are facing significant challenges due to a lack of adequate protection. There are only two plantations that have protection; one plantation site has protection in the form of barbed wire fencing and the other has protection in the form of stonewall (Figure 6.11). The rest of the plantation sites are without any protection and are thus prone to damage by grazing animals and local people. Appropriate protection measures should be taken before conducting plantation activities to avoid damage to the plantation by grazing animals, trespassers and unauthorized harvesting.

Figure 6.11: Protection in the form of barbed wire fencing and stonewall

6.1.3.2. Maintenance

Only two out of all the forest ranges, the written information/evidence/records are available for maintenance/replacement of plants providing details of species and no. of plants planted. Measurement book containing records of fencing activities and SMC work was reported in one forest range only.

6.1.3.3. Monitoring

The deployment of chowkidaars/watchers to look after plantations was not reported in any of the forest ranges in the Gurugram division. The forest guard has to look after plantations, which are spread over a beat, making it troublesome for a forest guard to effectively monitor these sites. The forest department claimed that they do not get sufficient funds to deploy at least one chowkidaar for a ten-hectare plantation.

6.1.4. Scoring of the plantation works

The plantations carried out under the CAMPA scheme in the year of 2019-20, 2020-21 and 2021-22 in the Gurugram division scored an average of 134.5, out of 250 (Table 6.12). Overall, the score was satisfactory, considering the water-scarce rocky terrain in the Aravalli region, grazing pressure and severe anthropogenic disturbances observed in most plantation sites.

Table 6.12: Score obtained by the plantations in the Gurugram division

Sr.	Year	Range	Component	Name of the site	Survival	Growth	Species suitability	Site suitability	Protection	Extent	Journal	Map	Invasive	Species composition	Weeding and hoeing	Watch and ward
1	2019-2020	Gurugram	NPV-TP	Gairatpurbas/ Sakatpur section 4&5	4.0	15.0	10	10	0	20	0	0	0	5	0	0
2	2019-2020	Sohna	CA-TP	Gairatpur Bas Sec 4 & 5 Aravali	52.0	14.0	10	10	0	20	0	0	0	6	0	0
3	2020-2021	Gurugram	NPV-TP	Sikhopur section 4 & 5	60.0	14.0	10	10	0	20	0	0	0	5	0	0
4	2020-2021	Gurugram	NPV-TP	NSG Manesar	80.0	16.0	10	10	0	20	0	0	0	4	0	0
5	2020-2021	Gurugram	CA TP	Ghata section 4 & 5	65.0	13.0	10	10	0	20	0	0	0	4	0	0
6	2020-2021	Hailymandi	CA-TP Alkali model	Sarbasirpur RF	65.0	16.0	10	10	20	20	20	10	0	7	0	0
7	2020-2021	Hailymandi	NPV-TP	Patuda minor RD 42.890 to 69.100 L	57.0	15.0	10	10	0	20	20	10	0	7	0	0
8	2020-2021	Hailymandi	CA-TP	Jatauli Bundh RDO- Tail (L&R)	65.0	15.0	10	10	0	20	20	10	0	7	0	0
9	2020-2021	Sohna	CA-TP	Nuh Sub Branch RD 10 to 20	64.0	17.0	10	10	0	20	0	0	0	8	0	0
10	2020-2021	Sohna	CA-TP	Gurugram canal RD 51289	40.0	14.0	10	10	0	20	0	0	0	7	0	0
11	2020-2021	Sohna	CA-TP	Harchandpur distributory	70.0	16.0	10	10	0	20	0	0	0	7	0	0

12	2021-2022	Gurugram	CA-SP	Ghata section 4 & 5	45.0	12.0	10	10	0	20	0	0	0	5	0	0
13	2021-2022	Gurugram	CA-SP	Behrampur section 4&5	74.0	12.0	10	10	0	20	0	0	0	5	0	0
14	2021-2022	Gurugram	Eco-restoration model III	Bandhwari section 4&5	50.0	10.0	10	10	20	20	0	0	0	5	0	0
15	2021-2022	Hailyma ndi	CA-TP	Garhi Harsaru Farrukhnagar Rly. Line	18.0	13.0	10	10	0	20	0	0	0	6	0	0
					53.9	14.1	10.0	10.0	2.7	200	4.0	20	0.0	5.9	0.0	0.0

Success Story - Nuh Sub Branch, RD 10 to 20

The plantation site stretches over 10 RKM and has species like Papri, Arjun, Neem, Bakain, Gulmohar and Balamkheera. Overall survival rate of this plantation site is recorded as 64% and growth is quite good. Some patches of this plantation site have been adopted and maintained by local villagers. These adopted patches of plantation have been provided with proper protection in the form of fencing and watcher, and steady irrigation and thus exhibited excellent survival percentage and phenomenal growth. Due to sufficient soil moisture, termites, which is common problem in most of the plantation sites in Gurugram was not observed in this site. Since the plantation is managed by the local community, there are no reports of fire damages.

Figure 6.12: Adopted patches of Nuh Sub Branch plantation site

6.1.5. Non-plantation works: Fencing

Only one non-plantation site (Fencing) was evaluated in the Gurugram division (Figure 6.13). The fencing was found to be intact except at some points, where it was damaged by the local livestock population.

Table 6.13: Details of the evaluated fencing site

Barbed wire fence					
Barbed wire Fence Id/NO/Name	Length in measurement Book	Actual Length in field	% Variation	Present status-intact/worn out	Effectiveness of the Fence
Kasan section 4 & 5	11	11	0	Intact	Moderately effective

Figure 6.13: Non-plantation fencing (Kasan section 4 & 5)

Table 6.14: Score obtained by the fencing site in Gurugram division

	Scoring components	Full score	Obtained score
1	Working Status	20	20
2	Serving the purpose intended	20	20
3	Actual extent	20	20
4	Site suitability	10	10
5	Measurement book	10	10
6	Expenditure as per the APO	20	20
	TOTAL	**100**	**100**

6.2 FARIDABAD DIVISION

Table 6.15: CA (Compensatory Afforestation) plantation sites evaluated in Faridabad division

Year	Range	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
				2019-20							**March, 2023**
2019-20	Faridabad	CA TP	Badkal section 4 & 5	16.5 Ha	16.5 Ha	16500	16500	10065	61	4	
				2020-21							
2020-21	Ballabgarh	CA TP	RF Alipur	2.278 Ha	2.278 Ha	2278	2278	1868	82	6.5	
				2021-22							
2021-22	Ballabgarh	CA TP	DM road KM 18 to 30	3.11 Ha	3.11 Ha	3110	3110	1990	64	5	
2021-22	Faridabad	CA TP	Chainssa Distry. RD 76 to 119	5 Ha	5 Ha	5000	5000	2200	44	3.3	
2021-22	Ballabgarh	CA TP	Harchandpur Disty. 0 to 24 L&R	4.4 Ha	4.4 Ha	4400	4400	1804	41	4.2	
2021-22	Faridabad	CA TP	Gurgaon-Feeder RD 0-30. L&R	9.76 Ha	9.76 Ha	9760	9760	4392	45	5.6	
2021-22	Faridabad	CA TP	Gugaon Feder RD30 to 50 R	1.844 Ha	1.844 Ha	1844	1844	922	50	5.5	
2021-22	Faridabad	CA TP	Gurgaon Feder RD 0 to 30	3.1 Ha	3.1 Ha	3100	3100	1581	51	5.1	

Table 6.16: NPV (Net Present Value) plantation sites evaluated in Faridabad division

Year	Range	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
					2019-20						**March, 2023**
2019-20	Faridabad	NPV TP	Tilpat Firing Range	4 RKM	4 RKM	1000	1000	580	58	3.5	
2019-20	Ballabgarh	NPV TP	Harchand Distributries	7 RKM	7 RKM	1750	1750	1085	62	4.3	
2019-20	Ballabgarh	NPV TP	Fatehpur Tagah Minor	8 RKM	8 RKM	2000	2000	1200	60	3.5	

6.2.1 Relevance

6.2.1.1. Site suitability

- Plantations in Reserve Forest (RF) have performed well

Plantation sites situated in the Reserved Forest area have performed well. Legally, grazing is not allowed in this area, which saved the plantation from illegal grazing. Anthropogenic disturbances were also found to be very low (Figure 6.14) which resulted in satisfactory survival and growth of the planted species.

Figure 6.14: RF Alipur plantation site produced excellent results

Although most of the sampled sites produced satisfactory survival, some of them were found to be impacted by heavy grazing, garbage dumping, fire, and the abundance of invasive species. Plantation should be taken up only after the drivers of degradation have been controlled or adequate mitigation steps have been put in place. These site suitability factors are discussed in more detail below:

- Impact of cattle grazing

Cattle grazing is one of the main factors to be considered in an afforestation or reforestation project. Moderate to heavy grazing was observed in most of the plantation sites (Figure 6.15). Most of the cattle were feral cows, while some of them were domestic belonged to the local villagers. Proper protection measures should be taken to prevent the plantation from the cattle.

Figure 6.15: (1) Domestic cattle grazing in roadside plantation (2) Plants were destroyed due to severe grazing

❖ Abundance of invasive species

Another detrimental factor that can cause serious damage to the plantation in the long run, is the presence of invasive species. In every sampled site in the division, the presence of Invasive species was observed. The most detrimental was *Prosopis juliflora* (Figure 6.16), where the site became almost impenetrable. Most of the planted saplings under the canopy of *Prosopis* were found to be stunted, or dead. The presence of *Parthenium hysterophorus* and *Ageratum conzoides* was also noted in other sites. Both pre and post-plantation control of invasive species is needed to ensure the proper growth and survival of the plantation.

Figure 6.16: Abundance of Prosopis juliflora in the plantation sites

❖ Disturbances created by the local community

Some of the plantation sites were severely impacted by the local community (Figure 6.17). The plantation of Dadsiya Yamuna Protection Bundh NPV-TP, garbage dumping by the local people in the plantation is severely affecting the plantation. A large number of the saplings were also found to be destroyed, due to a land dispute between the villagers and the forest department. Proper awareness programs should be created by the FD to enhance the positive community participation and ensure the survival of the plantation. Proper and regular monitoring is also required in these type of sites.

Figure 6.17: (1) Garbage dumping in the plantation (2) Destroyed plants

6.2.1.2 Species Suitability

A total of 12 planted species (Table 6.17) were found in the plantation sites of Faridabad Division. Sheesham (*Dalbergia latifolia*) and Papdi (*Holoptelea integrifolia*) was found to be the most dominant than the others. Growth of Balamkheera (*Kigelia pinnata*) was found to be the highest in terms of height, among all the planted species (Figure 6.18).

Although, most of the species have performed very well, some of them were found to be extremely prone to frost and grazing, two of the main drivers of species-specific degradation in Faridabad.

- Neem (*Azadirachta indica*) and Bakain (*Melia azadirach*) were the most affected by frost. In some sites, every Neem sapling was covered by wheat straws to protect against frost. In some sites, Papdi was also found to be affected.
- Grazing is the key problem for every plantation site. Only Papdi was found to have survived the severe grazing and browsing by both wild and domestic animals.
- Water scarcity was also identified as a detrimental factor for the plantation. According to the local people, species like Lasoda (*Cordia myxa*), Kikar, and Jungle Jalebi (*Pithocelobium dulce*) should be opted more as planted materials.

Table 6.17: List of planted species found in the plantation sites of Faridabad Division

	Planted species	
	Local Name	**Botanical Name**
1	Sheesham	*Dalbergia sissoo*
2	Papdi	*Holoptelea integrifolia*
3	Balamkheera	*Kigelia pinnata*
4	Katsagon	*Heterophragma adenophyllum*
5	Arjun	*Terminalia arjuna*
6	Neem	*Azadirachta indica*
7	Alstonia	*Alstonia scholaris*
8	Kadam	*Neolamarckia cadamba*
9	Bakain	*Melia azedarach*
10	Jungle Jalebi	*Pithecellobium dulce*
11	Pilkhan	*Ficus virens*
12	Siris	*Albizia lebbeck*

Figure 6.18: Growth of Papdi and Kigelia was found to be exceptionally good

6.2.2. Effectiveness

6.2.2.1. Plant Survival

The overall survival of the plantations were found to be satisfactory (56%). The highest survival was found in the plantations from 2019-20 (60%), and the least were from 2021-22 (54%, Table 6.18). It occurred mostly because the anthropogenic disturbances severely affected the young saplings. The plantations from 2019-20 were less in number and carried out in relatively undisturbed areas (e.g. reserve forest), while the plantations from 2021-22 were mostly carried out roadside, with no protection measures at all. Also, infrequent monitoring could be a reason behind the lower survival rate in younger plantations.

Table 6.19: Year-wise average survival rate and average height

	Year	Survival %	Average Height (Ft.)
1	2019-2020	60%	3.83
2	2020-2021	56%	5.75
3	2021-2022	54%	4.78

6.2.2.2. Growth of the planted species

Among the planted species, Kadam (*Neolamarckia cadamba*) attained the tallest height in three years, followed by Bakain (*Melia azadarach*) and Balamkheera (*Kigelia pinnata*). Sheesham (*Dalbergia sisoo*), Neem (*Azadirachta indica*) and Kadam (*Neolamarckia cadamba*) attained the most height in 2019-20, 2020-21 and 2021-22 respectively (Table 6.19, Figure 6.19).

Table 6.19: Average height of species planted in different plantations in 3 years

	Planted species		Plantation year		
	Local Name	Botanical Name	2019-20	2020-21	2021-22
1	Sheesham	*Dalbergia sissoo*	5.4	5	4.35
2	Papdi	*Holoptelea integrifolia*	3.7	4.9	3.3
3	Balamkheera	*Kigelia pinnata*	4.1	-	5.25
4	Katsagon	*Heterophragma adenophyllum*	-	-	4
5	Arjun	*Terminalia arjuna*	3.8	-	3
6	Neem	*Azadirachta indica*	-	6.8	4.7
7	Alstonia	*Alstonia scholaris*	-	4.5	3.6

8	Kadam	*Neolamarckia cadamba*	-	-	6.5
9	Bakain	*Melia azedarach*	-	-	5.5
10	Jungle Jalebi	*Pithecellobium dulce*	3.5	-	-
11	Pilkhan	*Ficus virens*	4	-	-
12	Siris	*Albizia lebbeck*	-	3.5	-
	Average		**4.1**	**4.9**	**4.5**

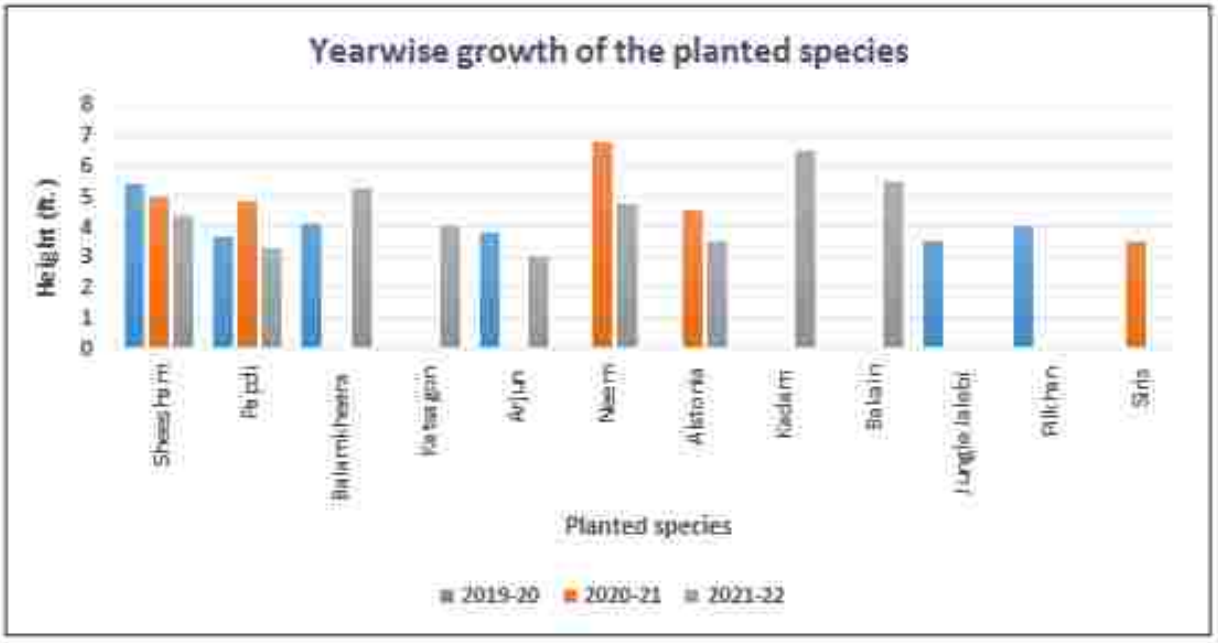

Figure 6.19: Graph showing the average height of species planted in different plantations in 3 years

6.2.3. Sustainability

6.2.3.1. Protection

Only four plantations were found with partial/full fencing (Figure 6.20); two peripheral fencing e.g. Stonewall fencing and barbed wire fencing and one tree-specific fencing e.g. bamboo tree guards.

The barbed wire fencing in "Yamuna Protection Bundh" (21-22) site was done by the concerned farmer, to protect the plantation and their own agricultural field. Another barbed wire fencing was found in "RF Alipur" site, which was done by the forest department to protect the forest and the plantation from cattle grazing.

Figure 6.20: Barbed wire fencing in (1) RF Alipur and (2) Yamuna Protection Bundh site

In the plantation site of "DM Road KM 18-30", bamboo tree guards (gabions) were used (Figure 6.21), specifically in the most disturbance-prone areas. The growth of the protected saplings was distinguishably better than those without protection.

Figure 6.21: (1) Stonewall fencing and (2) Bamboo tree guards

6.2.3.2 Monitoring

Since none of the sampled sites have any protection measures, the survival of the plantation entirely depends on the effectiveness of the watch and ward. The work is done by a watcher/ Chowkidaar, appointed by the Forest department from the nearby village. The problem is, the average assigned area for one watcher is more than 20 ha, which is beyond their capabilities. Lesser areas should be assigned to them to maximize their capabilities and to ensure proper monitoring.

6.2.4 Scoring of the plantation works

The plantations carried out under the CAMPA scheme in the year of 2019-20, 2020-21 and 2021-22 in the Faridabad division scored an average of 137.7, out of 250 (Table 6.20). Overall, the score obtained was satisfactory, considering the water-scarce rocky terrain in the area, grazing pressure and severe anthropogenic disturbances observed in most of the plantation sites.

Table 6.20: Score obtained by the plantations in Faridabad division

	Component	Year	Name of the Plantation site	Survival	Growth	Species suitability	Site suitability	Protection	Edent	Journal	Map	Invasive	Species composition	Weeding and hoeing	Watch and ward
1	CA TP	2019-2020	Badkal section 4 & 5	61	10	10	10	20	20	0	0	0	10	0	10
2	NPV TP	2019-2020	Tilpat Firing Range	58	10	10	10	0	20	0	0	0	10	0	10
3	NPV TP	2019-2020	Harchand Distributries	62	10	10	10	0	20	0	0	0	10	0	10
4	NPV TP	2019-2020	Fatehpur Tagah Minor	60	10	10	10	0	20	0	0	0	10	0	10
5	NPV TP	2020-2021	Dadasiya/Basantpur/ Issmailpur-Yamuna protection bundh	29	15	10	10	0	20	0	0	0	10	0	10
6	CA TP	2020-2021	RF Alipur	82	15	10	10	10	20	0	0	10	10	10	10
7	CA TP	2021-2022	DM road KM 18 to 30	64	15	10	10	20	20	0	0	10	10	10	10
8	CA TP	2021-2022	Chainssa Distry. RD 76 to 119	44	12	10	10	0	20	0	0	0	10	0	10
9	NPV TP	2021-2022	Yamuna protection bundh	55	20	10	10	10	20	0	0	0	10	0	10
10	CA TP	2021-2022	Harchandpur Disty. 0 to 24 L&R	41	20	10	10	0	20	0	0	0	10	0	10
11	NPV TP	2021-2022	Gonchi Main Drain RD 195-208	60	20	10	10	0	20	0	0	0	10	0	10
12	NPV TP	2021-2022	MITC Channal Village Bhainsrawli	59	20	10	10	0	20	0	0	0	10	0	10
13	CA TP	2021-2022	Gurgaon-Feeder RD 0-30, L&R	40	15	10	10	0	20	0	0	0	10	0	10
14	CA TP	2021-2022	Gugaon Feder RD30 to 58 right side	55	15	10	10	0	20	0	0	0	10	0	10
15	CA TP	2021-2022	Gurgaon Feder RD 0 to 30	52	14	10	10	0	20	0	0	0	10	0	10
				54.8	14.7	10.0	10.0	4.0	20.0	0.0	0.0	1.3	10.0	1.3	10.0

6.2.5. Non-plantation activity:

6.2.5.1. Soil and Moisture Conservation (SMC) measures

One Crate Wire, one Check Dam, one Soak pit and two percolation ponds were evaluated under this component (Figure 6.22). All the structures were found to be working very effectively.

Table 6.21: Evaluated SMC sites of the Fandabad division

	Year	Site Name	Name of SMC work	No of work	Size as per Measurement Book	Actual Size	Expenditure
1	2021-22	Pali section 4&5	Percolation Pond	1No	NA	72×50 m	788763
2	2021-22	Mohtabad Section 4&5	Percolation Pond	1 No	NA	70×50×1.5 m	800000
3	2021-22	Village Dhauj Sec-4 & 5	Crate Wire	3560 M3	NA	3560 M3	84,46,188
4	2021-22	Village Dhauj & kot sec-4 &5	Check Dam	500 m3	NA	500 m3	600000
5	2021-22	Dhauj Sec. 4 & 5	Soak Pit	1 no	NA	20×12×4 m	84,500




Figure 6.22: From the upper left: Soak pit of Dhauj Sec 4&5, Mahtabad Sec 4&5 percolation pond, Pali Bani percolation pond, Dhauj Sec 4&5 Check dam and Dhauj Sec 4&5 Crate wire

6.2.5.2 Fencing

One Barbed wire fencing, carried out in 2021-22 was evaluated. The fencing was found intact in most of the areas (Figure 6.23) but was found to be damaged in several places because of garbage dumping by the local people, construction workers and factories (Figure 6.24). Overall, the fencing was found to be working adequately.

Table 6.22: Evaluated Fencing site in Faridabad division

	Year	Kind of Fencing	Name of the Site	Target	Actual Area	Expenditure	Effectiveness
1	2021-22	Barbed Wire Fencing	DM ROAD KM 31 to 38	10 RKM	10 km	Rs 1877724	Effective

Figure 6.23: P Barbed wire fencing of DM Road KM 16-30

Figure 6.24. Fencing was damaged by construction dumping

6.2.5.3 Scoring of the non-plantation works

Table 6.23: Score obtained by the SMC sites in Faridabad division

	Scoring components	Full score	Obtained score
1	Working status	20	20
2	Site suitability	20	20
3	Measurement as per the APO	20	20
4	Fulfilling design specification	20	20
5	Measurement book	20	20
	TOTAL	**100**	**100**

Table 6.24: Score obtained by the fencing sites in Faridabad division

	Scoring components	Full score	Obtained score
1	Working Status	20	15
2	Serving the purpose intended	20	18
3	Actual extent	20	20
4	Site suitability	10	10
5	Measurement book	10	10
6	Expenditure as per the APO	20	20
	TOTAL	**100**	**93**

6.3 MAHENDRAGARH DIVISION

Table 6.25: CA (Compensatory Afforestation) plantation sites evaluated in Mahendragarh division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
2019-2020	MGarh	MGarh	CA TP	RF Salimabad	0.4 Ha	0.4 Ha	474	474	420	88.6	5.2	16-03-2023
2020-21												
2020-2021	Namaul	Namaul	CA TP	Thana Sec. 4 & 5	1.67 Ha	1.67 Ha	1676	1676	1450	86.5	4.9	21-03-2023
2020-2021	N. Choudhary	Nizampur	CA SP	Panchnota Sec. 4 & 5	31.14 Ha	31.14 Ha	31140	31140	24912	80	3	23-03-2023
2021-22												
2021-2022	MGarh	MGarh	CA TP	RF Salimabad	7.5 Ha	7.5 Ha	7500	7500	5475	73	3	16-03-2023
2021-2022	MGarh	Satnali	CA TP	RF Nangal Mala	9.43 Ha	9.43 Ha	9430	9430	7355	78	2.2	17-03-2023

Table 6.26: NPV (Net Present Value) plantation sites evaluated in Mahendrgarh division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
2019-20												
2019-2021	MGarh	Satnali	NPV TP	B.K.S Railway Line Km. 157-164 L&R Side	7 RKM	7 RKM	2750	2750	1550	56.4	6.4	17-03-2023
2019-2020	N. Choudhary	Nizampur	NPV TP	Nizampur to Namaul Rd. KM 0-8 L&R, Nizampur Rd to Maroli Rd KM 0-2 L&R	10 RKM	10 RKM	2500	2500	2000	80	6.8	22-03-2023
2020-21												
2020-2021	MGarh	Bhojawas	NPV TP	Kanina-Ateli Rd KM 14-27, L/R	8 RKM	8 RKM	2000	2000	1200	60	6.3	18-03-2023

2020-2021	MGarh		Nangal Sirohi	NPV TP	Bhandor Unchi Sec 4 &5	10 RKM	10 RKM	2500	2500	2300	92	6	18-03-2023
2020-2021	Namaul		Bacchod	NPV TP	Atell Distributory	8 RKM	8 RKM	2000	2000	1521	76.1	7.5	21-03-2023
2020-2021	N. Choudhary		Nizampur	NPV TP	Nizampur to Baba Rd	15 RKM	15 RKM	3750	3750	2200	58.7	4.9	22-03-2023
2020-2021	N. Choudhary		Nangal Durgu	NPV (Eco Restoration)	Golwa Sec. 4 & 5	60 Ha	60 Ha	12000	12000	10320	86	3.5	24-03-2023

6.3.1 Relevance:

6.3.1.1. Site suitability

- Sites adjacent to the agricultural field have performed well

Plantation sites, situated beside an agricultural field have performed well. Farmers apply fertilizer and manure to the agricultural crop, which also benefits the planted saplings. Sapling also has a steady supply of water from the irrigated agricultural field.

Although most of the sampled sites produced satisfactory survival, some of them were found to be impacted by heavy grazing, littering and abundance of invasive species. Plantation should be taken up only after the drivers of degradation have been controlled or adequate mitigation steps have been put in place. These site suitability factors are discussed in more detail below:

- Impact of cattle grazing

Cattle grazing is one of the main factors to be considered in an afforestation or reforestation project. Moderate to heavy grazing was observed in most of the plantation sites (Figure 6.25). Most of the cattle were feral cows that migrated from Rajasthan, while some of them were domestic, and belong to the local villagers. Proper protection measures should be taken to prevent the plantation from the cattle.

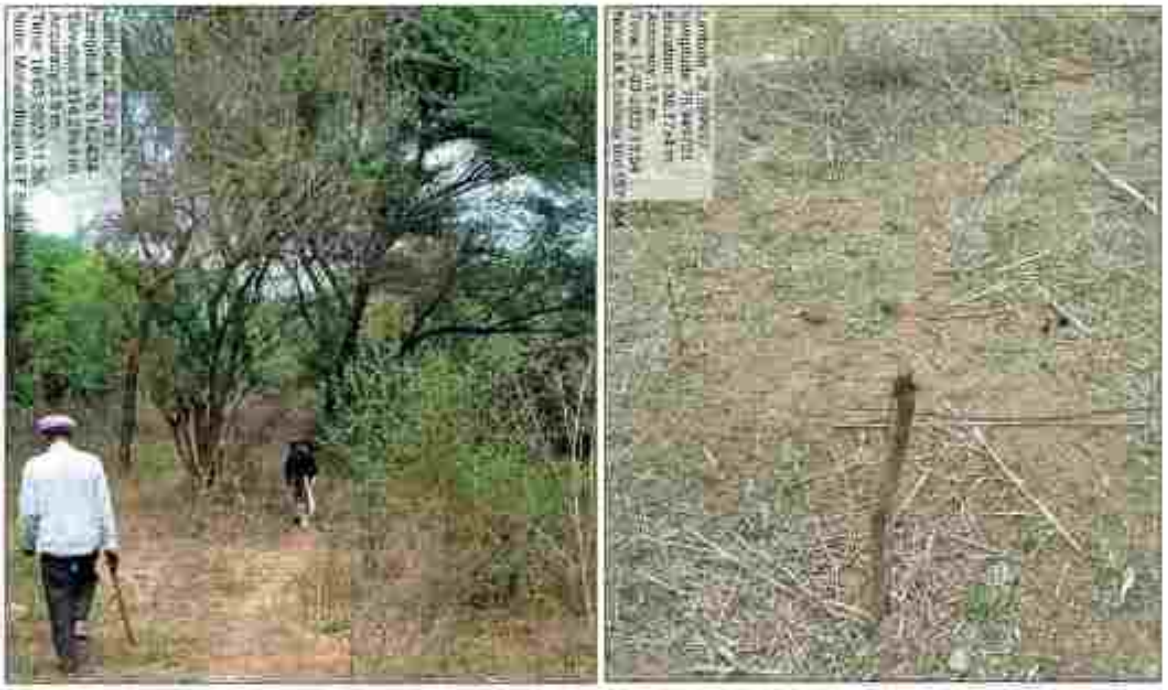

Figure 6.25: (1) Domestic cattle grazing in plantation (2) Plants were destroyed due to severe grazing

- Abundance of Invasive species

Another detrimental factor, that can cause serious damage to the plantation in the long run, is the presence of invasive species. In every sampled site in the division, the presence of Invasive species was observed. The most detrimental was *Prosopis juliflora* (Figure 6.26), where the site became almost impenetrable. Most of the planted saplings under the canopy of *Prosopis* were found to be stunted, or dead. Post-plantation control of invasive species is needed to ensure the proper growth and survival of the plantation.

Figure 6.26: Abundance of Prosopis juliflora in the plantation sites

- Disturbances created by the local community

Some of the plantation sites were severely impacted by the local community. Especially in the roadside plantations, garbage dumping by the local people is severely affecting the planted species (Figure 6.27). A large number of the saplings were also found to be destroyed, due to a land dispute between the villagers and the forest department. Proper awareness programs should be created by the FD to enhance the positive community participation and ensure the survival of the plantation. Proper monitoring is also required in these types of sites.

Figure 6.27: Garbage dumping on the plantation

6.3.1.2 Species Suitability

- Growth of Papdi and Neem was exceptionally good

Out of the 13 planted species, the growth of Neem and Papdi was found to be exceptionally good (Figure 6.28). Both of them are fast-growing species, and the livestock usually do not browse on them. Frost is one of the main reasons behind the declining growth of these species in some sites.

Figure 6.28: Growth of (1) Neem and (2) Papdi was very good in most of the sites

Although, most of the species have performed very well, some of them were found to be extremely prone to frost and grazing, two of the main drivers of species-specific degradation observed in Mahendragarh.

- Neem (*Azadirachta indica*) and Bakain (*Melia azadirach*) was found to be the most affected by frost. In some site, every individual Neem saplings were covered by *Sachharum* straws, as a protection measure against frost (Figure 6.29).

Figure 6.29: Neem saplings were protected by using traditional protection tools made by the watcher

- Grazing is the key problem for every plantation site. Only Papdi was found to be survived the severe grazing and browsing by both wild and domestic animals.
- Water scarcity was also identified as a detrimental factor for the plantation. According to the local people, species like Lasoda (*Cordia myxa*), Kikar (*Acacia nilotica*), and Jungle Jalebi (*Pithocelobium dulce*) should be opted more as planted materials.

Table 6.27: List of planted species observed in Mahendragarh Division

Sr. No	Planted Species	
	Local Name	Botanical Name
1	Neem	*Azadirachta indica*
2	Papdi	*Holoptelea integrifolia*
3	Siris	*Albizia lebback*
4	Bakain	*Melia azadarach*
5	Pilkhan	*Ficus virens*
6	Gundan	*Cordia myxa*
7	Gugal	
8	Beri	*Ziziphus jujuba*
9	Raunjh	*Acacia leucophlea*
10	Khair	*Acacia catechu*
11	Shisham	*Dalbergia latifolia*
12	Imli	*Tamarindus indica*

6.3.2. Effectiveness

6.3.2.1. Plant Survival

The overall survival of the plantations was found to be satisfactory (76.3%). The highest survival was found in the plantations from 2020-21 (77%), and the least were from 2019-20 (75%, Table 6.28). The reasons behind the decline in some sites are the disturbances (garbage dumping, encroachment etc.) created by the local people. In most of the plantations,

there were no adequate protection measures at all, making all the planted saplings vulnerable.

Table 6.29: Year-wise average survival rate and average height

Year	Survival %	Height (Ft.)
2019-2020	75.0	5.77
2020-2021	77.0	4.05
2021-2022	75.5	2.42

6.3.2.2 Growth of the planted species

A total of 13 planted species were found in the plantations of the Mahendragarh division. Papdi (*Holoptelea integrifolia*) was found to be the most planted species, followed by Neem (*Azadirachta indica*) and Sheesham (*Dalbergia latifolia*) (Table 6.29 & Figure 6.30).

Table 6.29: Year-wise average height of the planted species

Sr. No	Planted Species		Average Height (Ft.)		
	Local Name	Botanical Name	2019-20	2020-21	2021-22
1	Neem	*Azadirachta indica*	7.2	6.4	2.5
2	Papdi	*Holoptelea integrifolia*	5.9	4.2	2.75
3	Siris	*Albizia lebback*	7.6	6.6	-
4	Bakain	*Melia azadarach*	6	-	-
5	Pilkhan	*Ficus virens*	-	4.1	-
6	Gundan		-	4.5	-
7	Gugal		-	2.5	-
8	Beri	*Ziziphus jujuba*	-	2.8	-
9	Raunjh	*Acacia leucophlea*	-	3	-
10	Khair	*Acacia catechu*	-	2	-
11	Shisham	*Dalbergia latifolia*	-	5.8	2
12	Imli	*Tamarindus indica*	-	2.8	-
Average			5.8	4.1	2.4

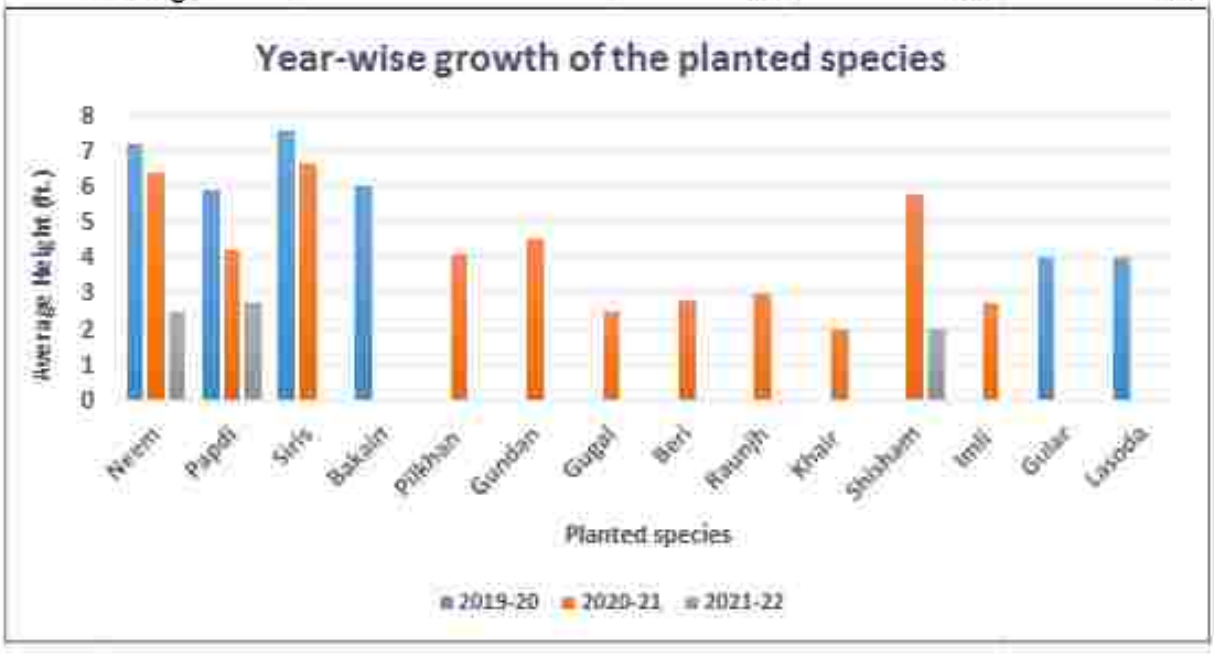

Figure 6.30: Graph showing the average height of the planted species in different plantations in 3 years

6.3.3. Sustainability

6.3.3.1. Protection

In most of the sites, no adequate protection measure was found. However, in a few sites, Cattle Proof Trench (CPT) and Stonewalls were used as peripheral fencing (Figure 6.31).

Figure 6.31: Stonewall fencing in the plantation of Golwa Sec 485

In some sites, frost-prone plants like Neem were protected by using "Pula". It is a traditional tree-specific protection technique, where each and every individual planted saplings were protected by a covering made out of *Sachharum* straws (figure 6.32).

Figure 6.32: Frost-prone Neem plants were protected by using "Pula"

6.3.3.2 Maintenance

The written information/evidence/records for maintenance/replacement of plants such as plantation journals, APOs, plantation maps etc., have not been maintained in most of the sites. This is one of the major shortcomings seen across the ranges of Mahendragarh division.

6.3.3.3 Monitoring

Since most of the sampled sites do not have adequate protection measure, the survival of the plantation entirely depends on the effectiveness of the watch and ward. The work is done by a watcher/ Chowkidaar, appointed by the Forest department from the nearby village. The problem is, the average assigned area for one watcher is more than 20 ha, which is beyond their capabilities. Lesser area should be assigned to them to maximize their capabilities and to ensure proper monitoring.

6.3.4. Scoring of the plantation works

The plantations carried out under the CAMPA scheme in the year of 2019-20, 2020-21 and 2021-22 scored an average of 204.8, out of 250 (Table 6.30). Overall, the score obtained was excellent, considering the water-scarce rocky terrain and severe anthropogenic disturbances observed in most of the plantation sites.

Table 6.30: Score obtained by the plantations in Mahendragarh division

Sr.	Year	Range	Component	Name of the site	Survival	Growth	Species suitability	Site suitability	Protection	Extent	Journal	Map	Invasive	Species composition	Weeding and hoeing	Watch and ward
1	2019-2020	MGarh	CA TP	RF Salimabad	88.6	200	10	10	0	20	20	20	10	10	10	10
2	2019-2021	MGarh	NPV TP	B.K.S Railway Line Km. 157-164 L&R Side	56.4	200	10	10	0	20	20	20	0	10	0	10
3	2019-2022	N. Choudhary	NPV TP	Nizampur to Namaul Rd. KM 0-8 L&R, Nizampur Rd to Maroli Rd KM 0-2 L&R	80.0	200	10	10	0	20	20	20	0	10	0	10
4	2020-2021	MGarh	NPV TP	Kanina-Ateli Rd KM 14-27, L/R	60.0	200	10	10	0	20	0	0	0	10	0	10
5	2020-2021	MGarh	NPV TP	Bhandor Unchi Sec 4 &5	92.0	200	10	10	20	20	0	0	10	10	10	10
6	2020-2021	Namaul	NPV TP	Ateli Distributory	76.1	170	10	10	0	20	20	20	10	10	0	10
7	2020-2021	Namaul	CA TP	Thana Sec. 4 & 5	86.5	200	10	10	0	20	20	20	10	10	0	10
8	2020-2021	N. Choudhary	NPV TP	Nizampur to Baba Rd	58.7	200	10	10	0	20	20	20	0	10	0	10
9	2020-2021	N. Choudhary	CA SP	Panchnota Sec. 4 & 5	80.0	200	10	10	20	20	20	20	0	10	0	10

10	2020 - 2021	N. Choudhary	NPV (Eco Restoration)	Golwa Sec. 4 & 5	86.0	200	10	10	20	20	20	20	0	10	0	10
11	2021 - 2022	MGarh	CA TP	RF Salimabad	73.0	200	10	10	10	20	20	20	10	10	10	10
12	2021 - 2022	MGarh	CA TP	RF Nangal Mala	78.0	160	10	10	20	20	20	20	10	10	10	10
					76.3	19.4	10.0	10.0	7.5	20.0	16.7	16.7	5.0	10.0	3.3	10.0

Success Story: Bhandor Unchi Sec 4 & 5 (2020-21), Mahendragarh

This plantation produced the highest survival rate (92%) among all the plantation sites in Mahendragarh division. Spread across 10 ha, it has Neem, Shisham, Gundan, Sirs, Gular and Pahadi Papdi as planted species. Within two years of plantation, the site became home of several bird and reptile species. The forest guard, Mr. Jitendra Singh makes extra efforts to ensure that there is no grazing despite no permanent watcher has been employed.

Success Story: Thana Sec 4 & 5 (2020-21), Narnaul

It is small plantation (1.6 ha), situated on the hilly slope of the Aravalli hills. Despite having extreme water scarcity and rocky soil bed, this plantation produced an impressive survival (86.5%). The saplings of Neem and Papdi have attained very good height (7.5 and 5 ft. respectively). The plantation has no proper protection measure, but the chowkidaar looks after the area very effectively.

6.4 NUH-MEWAT DIVISION

Table 6.31: CA (Compensatory Afforestation) plantation sites evaluated in the Nuh-Mewat division

Year	Range	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants counted	Survival (%)	Average Height (Ft.)	Date of visit
						2019-20					
2019-20	Firozpur Jhirka	CATP	Mahu Section 4& 5	3.78 Ha	3.8 Ha	3796	3796	2300	60.59	4.03	30-03-2023
						2020-21					
2020-21	Firozpur Jhirka	CATP	Nagal Mubarikpur Section 4& 5	10 Ha	10 Ha	10000	10000	7950	79.5	8.75	14-04-2023
2020-21	Firozpur Jhirka	CATP	Mahu Section 4& 5	7.795 Ha	7.8 Ha	7951	7951	2749	34.58	4.13	30-03-2023
2020-21	Firozpur Jhirka	CASP	Nangal Mubarikpur Section 4& 5	5 Ha	5 Ha	5000	5000	4423	88.46	1.64	30-03-2023
						2021-22					
2021-22	Nuh	CATP	Terakpur	9.3 Ha	9.3 Ha	5356	5356	1500	28.005	2.62	06-04-2023
2021-22	Nuh	CATP	Mehrola Section 4& 5			3750	3750	2910	77.6	3.93	04-04-2023
2021-22	Punhana	CATP	Pinangao Section 4& 5			244	244	116	47.69	2.13	03-04-2023
2021-22	Nuh	CATP	Rangala Section 4& 5	6.25 Ha	6.25 Ha	6240	6240	4540	72.75	4.92	08-04-2023

2021-22	Firozpur Jhirka	CATP	Agon Section 4& 5	1.488 Ha	1.488 Ha	1478	1478	1378	93.23	5.41	28-03-2023
2021-22	Firozpur Jhirka	CATP	Ghaghas Section 4& 5	9.07 Ha	9.07 Ha	9170	9170	7819	85.27	5.41	29-03-2023

Table 6.32: NPV (Net Present Value) plantation sites evaluated in Nuh-Mewat division

Year	Range	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants counted	Survival (%)	Average Height (Ft.)	Date of visit
						2019-20					
2019-20	Nuh	NPV TP	Didhara – Jorashi Road	10 RKM	10 RKM	2500	2500	2089	83.57	13.94	07-04-2023
2019-20	Firozpur Jhirka	NPV TP	Notki Bundh	10 RKM	10 RKM	2500	2500	1210	48.4	6.39	30-03-2023
						2020-21					
2020-21	Punhana	NPV TP	Punhana Gurgaon Canal	20 RKM	20 RKM	5000	5000	1472	29.44	3.34	03-04-2023
2020-21	Punhana	NPV TP	Sikrawa Gurgaon Canal	20 RKM	20 RKM	5000	5000	1120	22.4	4.42	03-04-2023
2020-21	Nuh	NPV Native	Sehsola Aravali	50 Ha	50 Ha	25000	25000	18000	72	14.76	09-04-2023
2020-21	Punhana	NPV EcoR	Tigaon Aravali	20 Ha	20 Ha	4000	4000	863	21.575	1.9	01-04-2023
2020-21	Nuh	NPV EcoR	Palla Section 4& 5	30 Ha	30 Ha	6000	6000	270	4.5	0.82	07-04-2023
						2021-22					
2021-22	Punhana	NPV TP	Ted Road	14 RKM	14 RKM	3500	3500	875	25	2.95	

2021-22	Punhana	NPV TP	Ujhina Drain	16 RKM	16 RKM	4000	4000	1230	30.75	3.11	03-04-2023
2021-22	Firozpur Jhirka	NPV TP	Hodal Nagina Road (32 to 38 km L/R)	15 RKM	15 RKM	3750	3750	2328	62.08	3.93	28-03-2023
2021-22	Firozpur Jhirka	NPV TP	Kotla Bandh	20 RKM	20 RKM	5000	5000	2910	58.2	2.95	10-04-2023
2021-22	Nuh	NPV Native	Sildho Aravali	60 Ha	60 Ha	42500	42500	10655	25.07	9.51	05-04-2023
2021-22	Nuh	NPV EcoR	Chharora Aravali	20 Ha	20 Ha	4000	4000	50	1.25	0.49	05-04-2023
2021-22	Nuh	NPV EcoR	Bissar Akbarpur Section 4& 5	20 Ha	20 Ha	4000	4000	290	7.25	0.95	06-04-2023

6.4.1 Relevance

6.4.1.1. Site Suitability

The Nuh division boasts a remarkable diversity of plantation sites, ranging from barren and rocky areas near the Aravali hills to fertile lands along drains and canals, as well as waterlogged plots. In the barren and harsh sites near the Aravalli hills, hardy species such as Pahadi Papdi, Kikar etc., are suitable, as they can withstand harsh environmental conditions. Most of them are thorny, which prevents them from being grazed.

- Plantation along the drains and canals has performed well

Due to the presence of a waterbody, the soil moisture was retained in the soil, preventing the saplings from drying out. Also, anthropogenic disturbances are much less than the roadside plantations (Figure 6.33). Planting trees on the sides of drains and canals in the Nuh Forest Division, Haryana brings about ecological benefits such as soil stabilization, improved water quality, and enhanced biodiversity. However, this initiative also faces challenges in terms of selecting suitable tree species and ensuring proper maintenance.

In sites with excessive waterlogging, species like Arjun (*Terminalia arjuna*), Bakain (*Melia azedarach*) and Sheesham (*Dalbergia latifolia*) are well-suited. The diverse range of plantation sites and suitable species in the Nuh division contribute to the overall ecological health and biodiversity of the region.

Figure 6.33: Plantation along the Canals

- Eco-restoration site was carried out in an unsuitable site

Plantations under Eco-restoration were carried out in the Aravalli region. The area mainly consists of a rocky soil bed with an abundance of *Prosopis* (Figures 6.34 & 6.35), which hampers the growth of the planted saplings. Hardy species such as Kikar, Reunjh etc. were planted in this area, but due to the rocky soil, most of the saplings were found to be stunted, or dead.

Figure 6.34: Plantation site with boulders

Figure 6.35: Eco-restoration plantation site with rocky upper soil

- Plantation works on bundhs were found to be challenging

Due to illegal stone mining and anti-social activities in the Aravalli areas, the plantation activities faced a serious threat. The monitoring of the existing plantations could not be done regularly due to these activities.

Plantation work on bundhs, particularly in areas surrounded by agricultural land and human population, faced several challenges. Firstly, the bunds themselves have uneven and steep terrain, making it physically demanding for workers to plant and establish vegetation on these elevated structures. These areas also consist of dry soil, with no moisture retention capacity. Plantations carried out on bunds showed moderate to poor survival (Figure 6.37).

Figure 6.36: Illegal mining in the plantation area

Figure 6.37: Plantation work carried out on Notki Bund showed moderate survival

- Impact of grazing pressure

Both domestic and feral cattle posed a serious threat to the plantations of the Nuh district. Most of the plantations do not have any kind of protection measure. Only a few sites in the division have protective measures like barbed wire fences and stone walls, but even these were found to be broken and poorly maintained, rendering them ineffective in safeguarding plants from animal damage. In many sites, cattle were found to be roaming inside the plantation (Figure 6.38).

Figure 6.38: Severe cattle grazing was observed on the plantation site

- Abundance of Invasive species

In the Nuh division, the presence of invasive species such as *Prosopis juliflora, Parthenium hysterophorus, Argemone mexicana* etc. was observed abundantly in most of the sites (Figure 6.39). Most of the planted species under the canopy of *Prosopis* were found to be stunted. The presence of these invasive species could be detrimental to the planted saplings, as well as the native flora. Pre-plantation eradication and frequent weeding after are highly recommended to secure the survival of the plantation.

Figure 6.39: Prosopis juliflora was found abundantly in every site in the Aravalli region

6.4.1.2. Species Suitability

- Growth and survival of Papdi was good

Papdi (*Holoptelea integrifolia*) was seen as the most commonly planted species in the division. It was distributed in 18 out of the 24 sites, surveyed. Its adaptability is evident as it thrives in diverse locations ranging from bunds and drains to areas adjacent to the Aravali hills. Papdi exhibits a remarkable overall survival, surpassing any other species in the region (Figure 6.40). Other planted species include *Azadirachta indica* (Neem), *Dalbergia sissoo* (Indian Rosewood), and *Albizia procera*.

Figure 6.40: Growth of the Holoptelea integrifolia (Papdi) in a plantation

- Hardy species were chosen for dry rocky soil

On the sites situated in the Aravali hills, *Acacia leucophloea* (Ronjh) and *Acacia catechu* (Khairi) are specifically chosen for their suitability in eco-restoration efforts. However, it is important to note that the survival rate of plants in these eco-restoration sites remains very low, indicating the need for further attention and improvements in this particular aspect of the region's restoration efforts.

Table 6.33: Planted species observed during Evaluation in the Nuh-Mewat Division

S.no.	Species Planted	
	Local Name	Botanical Name
1	Papdi	*Holoptelea integrifolia*
2	Neem	*Azadirachta indica*
3	Balamkheera	*Kigelia pinnata*
4	Sheesham	*Dalbergia sissoo*
5	Siris	*Albizia procera*
6	Gular	*Ficus racemosa*
7	Pilkhan	*Ficus virens*
8	Amaltas	*Cesia fistula*
9	Lasoda	*Cordia myxa*
10	Reunjh	*Acacia leucophoea*

11	Khair	*Acacia catechu*
12	Arjun	*Terminalia arjuna*
13	Jamun	*Syzgium cumini*
14	Alstonia	*Alstonia scholaris*
15	Bakain	*Melia azedarach*
16	Kachnar	*Bauhinia variegata*
17	Jungle jalebi	*Pithecellobium dulce*

6.4.3. Effectiveness

6.4.3.1. Survival of the plantation

The overall survival rate of plantations in the Nuh division was found to be satisfactory at 48.29%. Among the three plantation years, the highest survival rate was observed in the plantations carried out during 2019-20, with a rate of 64.18%. Conversely, the lowest survival rate was recorded for the plantations from 2020-21, which had a survival rate of only 44.05% (Table 6.34).

Table 6.34: Year-wise survival rate and average height of the plantation sites

	Year	Survival (%)	Avg. Height (ft.)
1	2019-2020	64.18	8.12
2	2020-2021	44.05	4.97
3	2021-2022	55.83	4.39

The plantation sites located on Aravallis, involving eco-restoration efforts, exhibited an alarmingly low survival rate ranging from 1.25% to 21.5%. The forest department encounters numerous challenges in conducting successful plantations due to factors like poor soil quality, water scarcity, and dry climatic conditions. To avoid wasting resources and efforts, it is imperative to conduct a comprehensive site suitability survey before initiating any plantation activities. This assessment will enable the identification of areas that possess optimal conditions for plant growth, thereby ensuring a higher survival rate and long-term sustainability.

6.4.3.2. Growth of the Plantations

Balamkheera (*Kigelia pinnata*), Sheesham (*Dalbergia sissoo*) and *Ficus racemosa* were the highest-growing species for the years 2019-20, 2020-21 and 2021-22 respectively (Table 6.35 & Figure 6.41).

Table 6.35: Average height of different plant species across three plantation years

S.no.	Species Planted		Plantation year		
	Local Name	Botanical Name	2019-2020	2020-2021	2021-2022
1	Papdi	*Holoptelea integrifolia*	5.4	4.0	3.9
2	Neem	*Azadirachta indica*	6.0	8.3	4.5
3	Balamkheera	*Kigelia pinnata*	15.0	-	-

4	Sheesham	*Dalbergia sissoo*	9.5	12.0	5.0
5	Siris	*Albizia procera*	11.0	11.0	4.3
6	Gular	*Ficus racemosa*	-	9.0	11.0
7	Pilkhan	*Ficus virens*	-	6.0	9.0
8	Amaltas	*Casia fistula*	-	9.0	-
9	Lasoda	*Cordia myxa*	-	5.5	-
10	Reunjh	*Acacia leucophoea*	-	1.5	0.8
11	Khair	*Acacia catechu*	-	0.9	1.0
12	Arjun	*Terminalia arjuna*	-	-	3.0
13	Jamun	*Syzgium cumini*	-	-	2.0
14	Alstonia	*Alstonia scholans*	-	-	2.5
15	Bakain	*Melia azedarach*	-	-	4.0
16	Kachnar	*Bauhinia variegata*	-	-	3.0
17	Jungle jalebi	*Pithecellobium dulce*	-	-	3.0

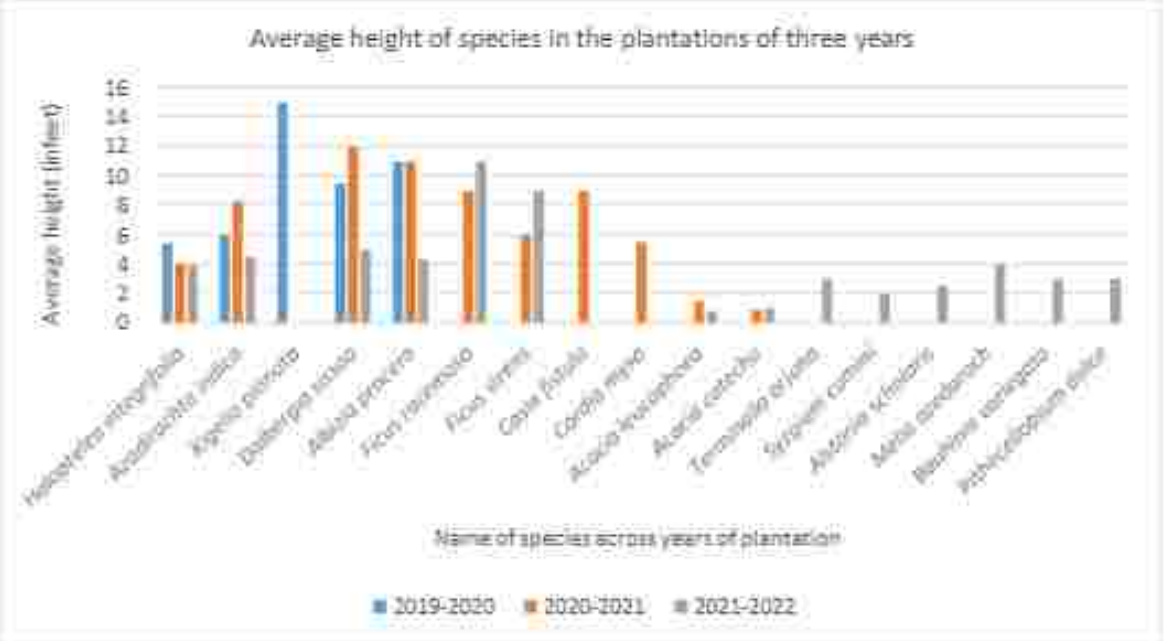

Figure 6.41: Average height of different plant species across three evaluation years

6.4.4. Sustainability

6.4.4.1. Protection

Most of the plantation sites are without proper protection measures such as fencing, tree guards, cattle-proof trenches etc., making these plantation sites prone to the damage inflicted by grazing and browsing animals. Appropriate protection measures should be taken before conducting plantation activities to avoid damage to the plantation by grazing animals, trespassers and unauthorised harvesting.

6.4.4.2 Maintenance

The written information/evidence/records for maintenance/replacement of plants such as plantation journals, APOs, plantation maps etc., have not been maintained in any forest range. This is one of the major shortcomings seen across the ranges of Nuh division.

6.4.4.3. Monitoring

Regular monitoring of the plantation is reported in all the plantation sites of the division. Chowkidaar/Watchers have been appointed in all the forest ranges to take care of plantation sites.

6.4.5. Scoring of the plantation works

The plantations carried out under the CAMPA scheme in the year 2019-20, 2020-21 and 2021-22 scored an average of 123.5, out of 250 (Table 6.36). Overall, the score obtained was satisfactory, considering the water-scarce rocky terrain in the Aravalli region, grazing pressure and severe anthropogenic disturbances observed in most of the plantation sites.

Table 6.36: Score obtained by the plantations in Nuh-Mewat division

Sr.	Year	Range	Component	Name of the site	Survival	Growth	Species Suitability	Site Suitability	Protection	Extent	Journal	Map	Invasive	Species composition	Weeding and Hoeing	Watch and Ward
1	2019-20	Firozpur Jhirka	CATP	Mahu Section 4& 5	60.59	20	10	5	0	10	0	0	10	10	5	10
2	2019-20	Nuh	NPV TP	Didhara – Jorashi Road	83.57	20	10	10	0	10	0	0	5	10	5	10
3	2019-20	Firozpur Jhirka	NPV TP	Notki Bundh	48.4	20	10	5	0	10	0	0	5	10	5	10
4	2020-21	Firozpur Jhirka	CATP	NagalMubarikpur Section 4& 5	79.5	20	10	10	0	10	0	0	10	10	5	10
5	2020-21	Firozpur Jhirka	CATP	Mahu Section 4& 5 (7.951 Hectare)	34.58	10	10	5	0	10	0	0	10	5	5	10
6	2020-21	Punhana	NPV TP	Punhana Gurgaon Canal	29.44	0	10	10	0	10	0	0	5	10	5	10
7	2020-21	Punhana	NPV TP	Sikrawa Gurgaon Canal	22.4	0	10	10	0	10	0	0	5	10	5	10
8	2020-21	Nuh	NPV Native	SehsolaAravali	72	20	10	10	10	10	0	0	10	10	5	10
9	2020-21	Punhana	NPV EcoR	TigaonAravali	21.575	0	5	10	10	10	0	0	10	10	5	10
10	2020-21	Nuh	NPV EcoR	Palla Section 4& 5	4.5	0	0	0	20	10	0	0	10	5	5	10
11	2020-21	Firozpur Jhirka	CASP	Nangal Mubarikpur Section 4& 5	88.46	20	10	10	0	10	0	0	10	10	5	10

12	2021-22	Nuh	CATP	Terakpur	28.005	0	5	0	10	10	0	0	10	10	5	10
13	2021-22	Nuh	CATP	Mehrola Section 4& 5	77.6	20	10	10	0	10	0	0	10	10	5	10
14	2021-22	Punhana	CATP	Pinangao Section 4& 5	47.69	15	10	10	20	10	0	0	10	10	5	10
15	2021-22	Nuh	CATP	Rangala Section 4& 5	72.75	20	10	10	20	10	0	0	10	10	5	10
16	2021-22	Firozpur Jhirka	CATP	Agon Section 4& 5	83.23	15	10	10	0	10	0	0	10	10	5	10
17	2021-22	Firozpur Jhirka	CATP	Ghaghas Section 4& 5	65.27	20	10	10	0	10	0	0	5	10	5	10
18	2021-22	Punhana	NPV TP	Ted Road	25	15	10	5	0	10	0	0	10	10	5	10
19	2021-22	Punhana	NPV TP	Ujhina Drain	30.75	15	10	10	0	10	0	0	10	10	5	10
20	2021-22	Firozpur Jhirka	NPV TP	Hodal Nagina Road (32 to 38 km L/R)	62.08	20	10	10	0	10	0	0	10	10	5	10
21	2021-22	Firozpur Jhirka	NPV TP	Kotla Bandh	58.2	15	10	10	0	10	0	0	10	10	5	10
22	2021-22	Nuh	NPV Native TP	SilkhoAravali	25.07	20	10	10	10	10	0	0	10	5	5	10
23	2021-22	Nuh	NPV EcoR	Chharora Aravali	1.25	0	0	0	0	10	0	0	10	0	5	10
24	2021-22	Nuh	NPV EcoR	Bissar Akbarpur Section 4& 5	7.25	0	0	0	0	10	0	0	10	0	5	10
Average					**48.3**	**12.7**	**8.3**	**7.5**	**4.2**	**10**	**0**	**0**	**9**	**8.5**	**6**	**10**

6.4.6. Non- Plantation Activities

6.4.6.1. Fencing

Fencing was evaluated in 4 sites (Table 6.37). Among these, Babupur and Kotla sites were found with completely damaged, worn-out barbed wire fences. In the other sites, Tarakpur and Mahu sections 4 & 5, partially intact and moderately effective fences were found (Figures 6.42, 6.43, & 6.44).

After conducting the audit of the fencing work, it is evident that the fences are not intact and are not effectively serving their purpose. This is a matter of concern as it compromises the security and protection of the plantations. Immediate action is required to address these issues and ensure that the fences are repaired or replaced to ensure their effectiveness.

Table 6.37: Details of evaluated fencing sites of the Nuh Mewat division

Year	Range	Barbed wire Fence Id/NO/Name	Length in measurement Book	Actual Length in Field	% Variation (+/-)	Present status	Effectiveness of the Fence
		Mahu Section 4& 5	15	15	0	Intact	Moderately effective
		Tarakpur	3.16	3.1	0	Partially Intact	Moderately effective
		Babupur	1.2	1.2	0	Worn out	Non-effective
		Kotla	1.27	1.3	0	Worn out	Non-effective

Figure 6 42: Fencing of the Terakpur site shows both intact and damaged parts

Figure 6.43: Fencing in the Babupur site was found completely damaged and ineffective

Figure 6.44: Completely damaged and ineffective fencing at the Kotla site

6.4.6.2. Soil and Moisture Conservation (SMC) works

In the Nuh division, a comprehensive evaluation of a pond structure was conducted in the Firozpur Range. Despite the current dry conditions, the pond structure remains well-maintained, showcasing its resilience even in the arid summer months. While the absence of water is expected during this period in such a dry region, it is important to note that the pond structure has retained its dimensions, ensuring its functionality when the rains arrive.

Furthermore, the other SMC works such as check dams and crates were evaluated in both the Firozpur Jhirka Range and the Nuh Range. These check dams have proven to be highly effective in their purpose of moisture conservation, as well as preventing soil erosion and facilitating rainwater harvesting (Figure 6.45).

Table 6.38: Details of evaluated SMC sites of the Nuh Mewat division

	Year	Range	Components	Name	Size in Measurement Book	Actual Size (Width * Depth* Length) in field	Expenditure (Rs.)
			Check Dam	Palla Section 4& 5	NA	1.5 x 1.1 x 9.5	20,06,905
			Crate Wire	N Mubarikpur Section 4& 5	NA	1.5 x 0.9 x 10.1	26,46,000
			Pond	Agon Section 4& 5	NA		6,10,429
			NPV Check Dam	Mahoon Section 4& 5	NA	2 x 2 x 10.3	16,89,100

Figure 6.45: Crate wire and check dam structures in Nuh division

6.4.6.3. Scoring of the non-plantation activities

Table 6.39: Score obtained by the fencing sites in Nuh-Mewat division

	Scoring components	Full score	Obtained score
1	Working Status	20	15
2	Serving the purpose intended	20	12.5
3	Actual extent	20	20
4	Site suitability	10	10
5	Measurement book	10	0
6	Expenditure as per the APO	20	20
	TOTAL	**100**	**77.5**

Table 6.40: Score obtained by the SMC sites in Nuh-Mewat division

	Scoring components	Full score	Obtained score
1	Working status	20	20
2	Site suitability	20	20
3	Measurement as per the APO	20	20
4	Fulfilling design specification	20	20
5	Measurement book	20	0
	TOTAL	**100**	**80**

6.4.7. Analysis of the design of the CAMPA works in Nuh-Mewat

6.4.7.1. Addressing the drivers of degradation before planting

In sites where the rate of biomass removal (grazing, harvesting, firewood collection etc.) is faster than primary production, it is imperative to address the livelihood needs of the local community before afforestation (or restoration) is attempted. Afforestation projects implemented in isolation without addressing the causes and drivers of deforestation in consultation with the local community will remain a 'band-aid' approach to degradation and not provide a lasting cure (Blignaut 2009).

The drivers of degradation such as over-grazing, tree felling, forest fires, the tragedy of the commons, infestation by invasive species, weak enforcement, etc. in the proposed restoration sites need to be identified and plantations should commence only when these have been effectively addressed. The most apt way would be to involve and consult with the local communities in site identification, species selection execution and protection leading to restoration so that they develop a sense of ownership.

We suggest that the prescribed plantation models need to factor in the ground situation. The main causes of plantation failure are grazing, drought, frost, fire, floods, local disturbances etc. These threats existed even before the plantations were planned, and addressing these threats using mitigation and adaptation measures should be made a precondition before the plantation is taken up. In sites, where this is not possible, plantations should not be taken up as they will probably meet the same fate as the original forests that got degraded. The second option is to adopt a mitigation strategy wherein the design of the plantation model adequately takes into account these threats and risks such as mound plantations in water-logged areas, selecting species that can withstand water logging, effective fencing in grazed areas, community partnership and ownership, provision of watering during summer and winter etc. Freedom and flexibility need to be provided to the forest divisions to include these components in the existing plantation models based on site-specific threat perception and locality factors.

6.4.7.2 Deploying Adequate Protection Measures

Proper protection measures are necessary to protect the plantation from various anthropogenic disturbances such as grazing, illegal cutting, littering etc. Perimeter fencing with barbed wire or Cattle Proof Trench (CPT) is mostly opted for, but with a fewer number of saplings, the tree-specific bamboo gabion is more effective and ecologically sound.

From the Key Informant Interviews, we got the information that the fund allocated to fencing comes months, even in some cases years, after the plantation. In some ranges, no funds were allocated to perimeter fencing, leaving the plantation unprotected and vulnerable to anthropogenic disturbances.

After observing the plantation sites, we suggest that in the case of a roadside plantation, fewer number of plants should be planted with better protection measures to ensure the survival of the plantation. In case of a block plantation, Barbed Wire fencing in non-forested land and Cattle Proof Trench in forested land should be adopted.

6.4.7.3 Plantation species mix should be reshuffled

In most of the sites, native species like Papdi, Sheesham, Arjun etc. were planted. But Focus Group Discussions and Key Informant Interviews revealed that with Papdi (*Holoptelea integrifolia*), hardy species like Lasoda (*Cordia myxa*), Kikar (*Acacia nilotica*), Khejdi (*Prosopis cineraria*), Reunjh (*Acacia leucophloea*) also can be added to the existing species mix. All these species can withstand frost, grazing, and extreme dry weather. These species are also likable to the local people. Instead of just increasing the green cover, we should focus on creating a balanced ecosystem where the local biodiversity can be restored and conserved.

6.4.7.4 An achievable target should be given to the forest ranges

Our data revealed that in many forest ranges, unrealistically large targets were given and the forest ranges were forced to carry out plantations in areas with unfavorable edaphic conditions. Due to the lack of suitable areas and huge targets, sites with an abundance of invasive species and severe anthropogenic disturbances were selected. As a result, 2-4-year-old saplings were found to be stunted due to intense grazing. The concerned range office should be consulted regarding the target area and species before the initiative. According to the key informants, fewer saplings in a suitable site with adequate protection measures will produce excellent growth and survival.

6.4.7.5 Record keeping needs to be strengthened

Record-keeping was found to be inadequate in almost all the sampled sites. The actual ownership of the sites was not verified due to the lack of proper documents. The number of replaced samplings also could not be verified. The plantation sites on the ground also lack any kind of demarcation (plantation board), which created difficulties in identifying and verifying the sites from the APO.

It is highly suggested that plantation journals in the prescribed format should be maintained and kept updated to enable effective monitoring and evaluation. The plantation journal needs to include a site map, soil details, plantation polygon points, pits dug, the species-wise breakup of plants planted, breakup of a site into sectors/patches, process photos etc. Internal inspection reports of supervising officers also need to be entered into these registers. Maintaining these journals should be made a mandatory requirement and their quality checked before final payments for the works are released. Also, the geo-referenced plantation polygon of the perimeter of the plantation as a KML file should be diligently recorded and stored with the division office for future reference. This will enable better monitoring and evaluation as detailed documentation of the works is readily available. Proper plantation boards with name, area, co-ordinates and species planted should be installed in every plantation site to avoid any unwanted complications in identifying the site.

6.5 PALWAL DIVISION

Table 6.41: CA (Compensatory Afforestation) plantation sites evaluated in Palwal division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
2019-20	Hodal	Hassanpur	CA TP	Hassanpur Un-Classed Forest	0.025 Ha	0.025	25	25	25	100	10.2	27-03-2023
2021-22	Hodal	Hassanpur	CA TP	Hassanpur Un-Classed Forest	6.007 Ha	6 Ha	6007	6007	4550	75.74	5.5	27-03-2023

Table 6.42: NPV (Net Present Value) plantation sites evaluated in Palwal division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
2019-20												
2019-20	Hodal	Hassanpur	NPV TP	UDD	15 RKM	15 RKM	3750	3750	2940	78.4	7.2	27-03-2023
2020-21												
2020-21	Palwal	Mandkola	NPV TP	Nuh-Palwal Road, 14-17 Km , L&R	6 RKM	6 RKM	1500	1500	1165	77.67	6.9	23-03-2023
2020-21	Palwal	Ghori	NPV TP	Rampur Khor Distributary, RD 67-75 L&R	7 RKM	7 RKM	1750	1750	1394	79.66	9.9	23-03-2023
2020-21	Hodal	Hodal	NPV TP	Hodal Dakora 1-5 Mafia Jalalpur Road, Km 0-3	8 RKM	12 RKM	2000	2000	1404	70.2	8.2	24-03-2023
2020-21	Palwal	Ghori	NPV Ridge	Sultanpur R/F, Mus No/Killa no-65/12,12,19,18,22,23) Must./Killa no	28 Ha	28 Ha	9240	9240	6440	69.7	8.2	22-03-2023

				83(2,3,4,5,6,7,8,14,15) Must No/Killa no/ (81/14,15)								
						2021-22						
2021-22	Palwal	Ghori	NPV TP	Amarpur-Mohna Road KM 0-6 L&R	12 RKM	12 RKM	3000	3000	1831	61.03	6.8	23-03-2023
2021-22	Hodal	Hodal	NPV TP	Hodal-Punhana road L/R Side KM 0-6	10 RKM	10 RKM	3250	3250	1609	49.51	5	24-03-2023
2021-22	Hodal	Hodal	NPV TP	GMD L/R Side RD 54-70	20 RKM	20 RKM	5000	5000	1733	34.66	4.4	27-03-2023
2021-22	Hodal	Hassanpur	NPV TP	GMD L/R RD 10-20	17 RKM	17 RKM	4250	4250	3575	84.12	7	24-03-2023

6.5.1. Relevance:

6.5.1.1. Site suitability

- Sites adjacent to the agricultural field have performed well

Plantation sites, situated beside an agricultural field have performed well. Farmers apply fertilizer and manure to the agricultural crop, which also benefits the planted saplings. Sapling also has a steady supply of water from the irrigated agricultural field. In some sites, farmers voluntarily took care of the saplings and created fencing around the plantation (Figure 6.46).

Figure 6.46: Alwalpur NPV-TP and Hodal Dakora NPV TP sites have shown good growth

- NPV Ridge sites have performed well

The main purpose of the ridge plantation is either to save the saplings from waterlogging or retain moisture in the soil in the dry region. In the NPV Ridge site of this division, all the planted species have performed very well due to the retained soil moisture inside the furrows (Figure 6.47). Also, the site was regularly monitored and ridges were found to be maintained properly.

Figure 6.47: Kikar shows excellent growth in the NPV Ridge plantation

Although most of the sampled sites produced satisfactory survival, some of them were found to be impacted by heavy grazing, littering and abundance of invasive species. Plantation should be taken up only after the drivers of degradation have been controlled or adequate mitigation steps have been put in place. These site suitability factors are discussed in more detail below:

❖ Impact of cattle Grazing

Cattle grazing is one of the main factors to be considered in an afforestation or reforestation project. Moderate to heavy grazing was observed in most of the plantation sites (Figure 6.48). Most of the cattle were feral cows, while some of them were domestic, belong to the local villagers. Proper protection measure should be taken to prevent the plantation from the cattle.

Figure 6.48: (1) Domestic cattle grazing in roadside plantation (2) Plants were destroyed due to severe grazing

❖ Abundance of invasive species

Another detrimental factor, that can cause serious damage to the plantation in the long run, is the presence of invasive species. In every sampled site in the division, the presence of Invasive species was observed. The most detrimental was Prosopis juliflora (Figure 6.49), where the site became almost impenetrable. Most of the planted saplings under the canopy of Prosopis were found to be stunted, or dead. The presence of Parthenium hysterophorum and Ageratum conzoides (Figure 6.49) was also noted in other sites. Post-plantation control of invasive species is needed to ensure the proper growth and survival of the plantation.

Figure 6.49: Abundance of Ageratum conzoides and Prosopis juliflora in the plantation sites

❖ Disturbances created by the local community

Some of the plantation sites were severely impacted by the local community. The plantation of Amarpur NPV-TP, garbage dumping by the local people in the plantation is severely affecting the plantation (Figure 6.50). A large number of the saplings were also found to be destroyed, due to a land dispute between the villagers and the forest department. Proper awareness programs should be created by the FD to enhance the positive community participation and ensure the survival of the plantation. Proper monitoring is also required in these type of sites.

Figure 6.50: (1) Garbage dumping in the plantation (2) Destroyed plants

6.5.1.2. Species Suitability

A total of 11 planted species were found in the plantation sites of Palwal Division. Sheesham (*Dalbergia latifolia*) and Papdi (*Holoptelea integrifolia*) was found to be the most planted species. Growth of Balamkheera (*Kigelia pinnata*) was found to be the highest in terms of the height, among all the planted species. Under NPV Ridge, the growth of Kikar (Acacia nilotica) was found to be extremely good (Figure 6.51).

Although, most of the species have performed very well, some of them were found to be extremely prone to frost and grazing, two of the main drivers of species-specific degradation in Palwal.

- Neem (*Azadirachta indica*) and Bakain (*Melia azadirach*) was found to be the most affected by frost. In some site, every individual Neem saplings were covered by wheat straws, as a protection measure against frost. In some site, Papdi was also found to be affected.
- Grazing is the key problem for every plantation site. Only Papdi was found to be survived the severe grazing and browsing by both wild and domestic animals.
- Water scarcity was also identified as a detrimental factor for the plantation. According to the local people, species like Lasoda (*Cordia myxa*), Kikar, Jungle Jalebi (*Pithocelobium dulce*) should be opted more as planted materials.

Figure 6.51: Growth of (1) Papdi and (2) Kikar was found to be exceptionally good

Table 6.43: List of planted species observed during the evaluation in Palwal division

Sr. No.	Planted species	
	Local Name	Botanical Name
1	Kikar	*Acacia nilotica*
2	Bakain	*Melia azadarach*
3	Shisham	Dalbergia sisoo
4	Jungle Jalebi	*Pithocellobium dulce*
5	P. Papdi	*Holoptelea integrifolia*
6	Neem	*Azadirachta indica*
7	Ber	*Ziziphus jujube*
8	B. Papdi	*Terminalia catapa*
9	Alstonia	*Alstonia scholaris*
10	Pilkhan	*Ficus virens*
11	Jamun	*Syzygium cumini*
12	Arjun	*Terminalia arjuna*
13	Balamkheera	*Kigelia pinnata*
14	Kadam	*Neolamarckia kadamba*

6.5.2. Effectiveness

6.5.2.1. Survival of the plantation

The overall survival of the plantations were found to be satisfactory (74.84%). The highest survival was found in the plantations from 2019-20 (89.20%), and the least were from 2021-22 (61.01%, Table 6.44). It occurred mostly because of the anthropogenic disturbances severely affected the young saplings. The plantations from 2019-20 were less in number and carried out in relatively undisturbed areas (e.g. unclassed forest), while the plantations from 2021-22 were mostly carried out roadside, with no protection measures at all.

Table 6.44: Year-wise average survival rate and average height

	Year	Survival (%)	Height (ft.)
1	2019-2020	89.20	8.7
2	2020-2021	74.31	8.3
3	2021-2022	61.01	5.3
	Average	**74.84**	7.4

6.5.2.2. Growth of the planted species

Among the 14 planted species, Sheesham (*Dalbergia latifolia*) and Bakain (*Melia azadarach*) have attained the tallest height (2019-20 and 2020-22 respectively, table 6.45 & Figure 6.52). Neem, Pahadi Papdi, Badam Papdi and Kikar have also obtained impressive heights. Jungle Jalebi was observed to have the least height, due to its slow-growing nature.

Table 6.45: Average height of the saplings (ft.) in plantations of different years

Sr No.	Planted species		Plantation Years		
	Local Name	Botanical Name	2019-20	2020-21	2021-22
1	Kikar	*Acacia nilotica*	-	10	-
2	Bakain	*Melia azadarach*	-	10.4	12
3	Shisham	Dalbergia sisoo	10.2	6.0	5.8
4	Jungle Jalebi	*Pithocellobium dulce*	-	5.1	3.8
5	P. Papdi	*Holoptelea integrifolia*	7.2	8.8	6
6	Neem	*Azadirachta indica*	-	9.1	6.1
7	Ber	*Ziziphus jujube*	-	7	-
8	B. Papdi	*Terminalia catapa*	7.1	-	-
9	Alstonia	*Alstonia scholaris*	-	6.3	4
10	Pilkhan	*Ficus virens*	-	-	6
11	Jamun	*Syzygium cumini*	-	-	5
12	Arjun	*Terminalia arjuna*	-	9	4
13	Balamkheera	*Kigelia pinnata*	-	13.1	5.6
14	Kadam	*Neolamarckia kadamba*	-	9	-

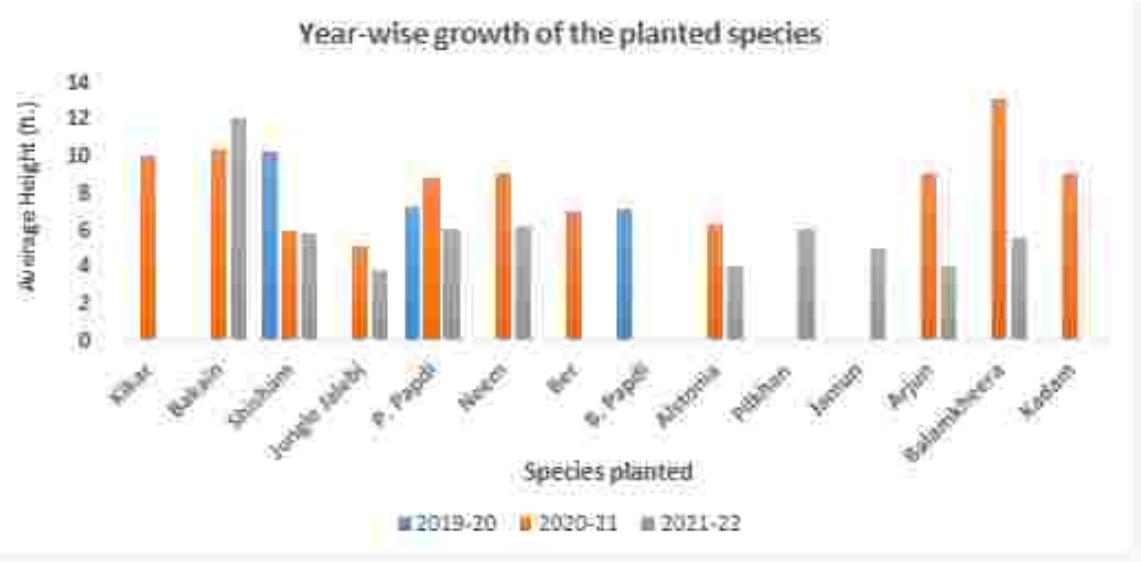

Figure 6.52: Graph showing the average height of the planted species in different plantations in 3 years

6.5.3. Sustainability

6.5.3.1. Protection

Only one plantation was found with partial barbed wire fencing (Figure 6.53). The fencing was done by the concerned farmer, voluntarily, to protect the plantation and their own agricultural field. Apart from this, no other forms of protection measures were found in any of the sampled site.

Figure 6.53: Farmers voluntarily created barbed wire fence to protect the plantation

6.5.3.2 Monitoring

Since none of the sampled sites have any protection measures, the survival of the plantation entirely depends on the effectiveness of the watch and ward. The work is done by a watcher/ Chowkidaar, appointed by the Forest department from the nearby village. The problem is, that the average assigned area for one watcher is more than 20 ha, which is beyond their capabilities. Lesser areas should be assigned to them to maximize their capabilities and to ensure proper monitoring.

6.5.3.3 Maintenance

The written information/evidence/records for maintenance/replacement of plants such as plantation journals, APOs, plantation maps etc., have not been maintained in any forest range. This is one of the major shortcomings seen across the ranges of the Palwal division.

6.5.4. Scoring of the plantation activities

The plantations carried out under the CAMPA scheme in the year of 2019-20, 2020-21 and 2021-22 scored an average of 156.7, out of 250 (Table 6.46). Overall, the score obtained was satisfactory considering the water-scarce terrain and severe anthropogenic disturbances.

Table 6.46: Score obtained by the plantations in Palwal division

Sr.	Year	Component	Name of Reach/ Site	Survival	Growth	Species suitability	Site suitability	Protection	Established	Journal	Map	Invasive	Species composition	Weeding and hoeing	Watch and ward
1	2019-20	CA TP	Hassanpur Un-Classed Forest	100.0	20	10	10	0	20	0	0	10	10	10	10
2	2019-20	NPV TP	UDD	78.4	18	10	10	0	20	0	0	0	10	5	10
3	2020-21	NPV TP	NuH-Palwal Road, 14-17 Km , L&R	77.7	16	10	10	0	20	0	0	0	10	5	10
4	2020-21	NPV TP	Rampur Khor Distributary, RD 67-75 L&R	79.7	20	10	10	0	20	0	0	0	10	5	10
5	2020-21	NPV TP	Hodal Dakora 1-5 Mafia Jalalpur Road, Km 0-3	70.2	20	10	10	0	20	0	10	0	10	5	10
6	2020-21	NPV Ridge	Sultanpur R/F, Mus. No/Killa no-65/12,12,19,18,22, 23)	69.7	20	10	10	0	20	0	0	0	10	5	10
7	2021-22	NPV TP	Amanpur-Mohna Road KM 0-6 L&R	61.0	18	10	10	0	20	0	0	0	10	0	10
8	2021-22	NPV TP	Hodal-Punhana road L/R Side KM 0-6	49.5	16	10	10	0	20	0	10	0	10	0	10
9	2021-22	NPV TP	GMD L/R Side RD 54-70	34.7	15	10	10	0	20	0	10	0	10	0	10
10	2021-22	CA TP	Hassanpur Un-Classed Forest	75.7	15	10	10	0	20	0	0	0	10	5	10
11	2021-22	NPV TP	GMD L/R RD 10-20	84.1	20	10	10	0	20	0	0	0	10	5	10
				71	**18**	**10**	**10**	**0**	**20**	**0**	**2.7**	**0.9**	**10**	**4.1**	**10**

Success Story: Rampur Khor Distributary (2020-21), Palwal

The site is located adjacent to agricultural fields, which could be one of the main reason behind the success of this plantation. The concerned farmers voluntarily deployed barbed wire fence, to protect the saplings. They also irrigate the plants, along with their crops. The forest guard and the chowkidaar used fertilizers to boost the growth of the saplings. Due to the combined effort of the forest dept and the community, the plantation produced a survival of 79.66%.

Figure 6.54: Protected by fencing, the saplings shows good growth and survival

6.5.5. Non-plantation activities

6.5.5.1. Fencing

The evaluation of Fencing was conducted at the Bamnikhera-Hassanpur Road site (Figure 6.55). After evaluation, it is evident that the fencing is intact and effectively serving its purpose. However, in some places, the fencing was found to be damaged by the local people to make way to their lands.

Table 6.47: Details of evaluated Fencing site in Palwal division

Year	Range	Barbed wire Fence Id/NO/Name	Length in measurement Book	Actual Length in field	% Variation (+/-)	Present status	Effectiveness of the Fence
2021-22	Hodal	Bamnikhera-Hassanpur road (Deeghot-Pingore) km 8-12	6 RKM	5.9 RKM	0	Intact	V Effective

Figure 6.55: Fencing at Bamnikhera-Hassanpur Site

6.5.5.2. Soil and Moisture Conservation (SMC) works

Two Stone Studs situated along the banks of the Yamuna River were evaluated at the Sultanpur RF site. Both the stone studs were found to be intact (Figure 6.56 & 6.57), and have proven to be highly effective in their purpose of prevention of soil erosion.

Table 6.48: Evaluated sites of SMC works in the Palwal division

Year	Range	Components	Name	Size in Measurement Book	Actual Size (Width * Depth* Length) in field	Expenditure (Rs.)
2021-22	Palwal	Stone Stud 1	Sultanpur RF	12 × 12 × 74	12.5 × 12 × 73	42,12,811
2021-22	Palwal	Stone Stud 6	Sultanpur RF	12 × 12 × 74	12 × 12 × 73.4	44,36,521

Figure 6.56: Stone Stud 2 in Sultanpur RF

Figure 6.57: Stone Stud 6 in Sultanpur RF

6.5.6. Scoring of non-plantation works

Table 6.49. Score obtained by the Fencing works

Scoring components	Full score	Obtained score
Working Status	20	20
Serving the purpose intended	20	20
Actual extent	20	20
Site suitability	10	10
Measurement book	10	0
Expenditure as per the APO	20	20
TOTAL	100	90

Table 6.50. Score obtained by the SMC works

Scoring components	Full score	Obtained Score
Working status	20	20
Site suitability	20	20
Measurement as per the APO	20	20
Fulfilling design specification	20	20
Measurement book	20	20
	100	100

6.6 REWARI DIVISION

Table 6.51: CA (Compensatory Afforestation) plantation Sites evaluated in Rewari Division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
						2019-20						
2019-2020	Rewari	Dahina	CATP	Maseet Section 4&5	20.936 Ha	20.936 Ha	5234	5234	3463	66.17	3.94	23-03-2023
						2020-21						
2020-2021	Rewari	Khol	CATP	Pali Section 38	21.72 Ha	21.72 Ha	21720	21720	18499	85.17	5.91	24-03-2023
						2021-22						
2021-2022	Nahar	Darheera	CATP	Karoli to Chuchakwas Road km 0 to 7 L&R	2.6 Ha	2.6 Ha	2600	2600	1900	73.08	6.56	22-03-2023
2021-2022	Nahar	Kosli	CATP	RH Railway line 22 to 32 L&R	4.3 Ha	4.3 Ha	4300	4300	3000	69.77	8.2	22-03-2023
2021-2022	Nahar	Nahar	CATP	RF Nahar	3.8 Ha	3.8 Ha	3800	3800	3400	89.47	4.59	22-03-2023
2021-2022	Bawal	Jhabua	CATP	Bawal-Dulhera Road (Rewari-Bawal Rd) km 12-13 L/s (0.05 RKM)	1.022 Ha	1.022 Ha	1022	1022	650	63.6	5.91	21-03-2023
2021-2022	Rewari	Darheera	CATP	Masani Bundh Recharge bundh (Sabi Bundh) Km 4-6 L/ Side	2.5 Ha	2.5 Ha	2500	2500	2273	90.91	3.28	20-03-2023
2021-2022	Rewari	Dahina	CATP	Didoli Section 4&5	5.255 Ha	5.255 Ha	5255	5255	4541	86.41	6.56	23-03-2023
2021-2022	Rewari	Khol	CATP	Khol Bundh	2.5 Ha	2.5 Ha	2500	2500	2100	84	3.94	24-03-2023

Table 6.52: NPV (Net Present Value) plantation Sites evaluated in Rewari Division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
2019-20												
2019-2020	Nahar	Nahar	NPV TP	Nehrugarh to Jhal km 0 to 2 L&R and Jhal to Surheli Mod km 0 to 1 L&R	5 RKM	5 RKM	1250	1250	1100	88	12.24	22-03-2023
2019-2020	Nahar	Kosli	NPV TP	Mubarikpur to Jaitpur Road km 0 to 3 L&R	5 RKM	5 RKM	1250	1250	1125	90	12.3	22-03-2023
2019-2020	Rewari	Daruhera	NPV TP	PSR Road. Km 63-69	6 RKM	6 RKM	1500	1500	1100	73.33	12.14	18-03-2023
2020-21												
2020-2021	Bawal	Jhabua	NPV TP	Bisharpur Disty. Km 0-4 L&R	3 RKM	3 RKM	750	750	550	73.33	7.22	21-03-2023
2020-2021	Bawal	Jhabua	NPV TP	Jhabua Disty. Km 0-3 L&R	3 RKM	3 RKM	750	750	500	66.67	11.61	21-03-2023
2020-2021	Bawal	G. Boli	NPV TP	JLN Canal Km 37-42 L&R	25 RKM	25 RKM	6250	6250	5300	84.8	12.14	20-03-2023
2020-2021	Rewari	Daruhera	NPV TP	Nikhri - Bhatsana- Jarthal NRP Bass Road	14 RKM	14 RKM	3500	3500	2800	80	10.5	18-03-2023
2021-22												
2021-2022	Bawal	Bawal	NPV TP	NH-8 (Bawal) to Manka Road. Km 0-5 L&R	8 RKM	8 RKM	2000	2000	1500	75	6.07	20-03-2023
2021-2022	Rewari	Daruhera	NPV TP	Chillar to Karawara Road. To NH-71 Rd. Km 0 to 8, L&R	10 RKM	10 RKM	2500	2500	2100	84	5.58	19-03-2023
2021-2022	Rewari	Daruhera	NPV TP	Kakodia NH71 Ghurkawas to Nayagaon Road	10 RKM	10 RKM	2500	2500	2300	92	15.75	19-03-2023
2021-2022	Rewari	Daruhera	NPV TP	Massni Bundh	20.9 RKM	20.9 RKM	5225	5225	4703	90	9.84	18-03-2023
2021-2022	Rewari	Daruhera	NPV TP	NH-8 (kamal hotel) to IG office to Treatment plant kharkhara	22 RKM	22 RKM	5500	5500	5000	90.91	4.92	17-03-2023

6.6.1. Relevance

6.6.1.1. Site Suitability

Plantation sites that were located adjacent to canals and distributaries were best suited for the plantations due to the high water table and availability of water throughout the year. Roadside plantations on tertiary roads, in the proximity of villages and agricultural lands, were also observed as suitable sites for plantation activities (Figure 6.58). These sites are accessible for periodic watering, are less prone to vandalism and also derive benefits from the nearby agricultural fields in the form of water and fertilizers for their growth. In addition to this, plantations inside Reserve Forests were also found to be suitable due to the low impact of anthropogenic disturbances and cattle grazing.

Figure 6.58: Tertiary and village roads next to agricultural lands are good sites for NPV plantations. Picture from Nikhri-Bhatsana-Jarthal NRP Road (2020-2021 plantation)

On the contrary, plantation sites on National Highways and Railway Lines were majorly affected by vandalism, grazing and littering (Figures 6.59 & 6.60). Railway Line plantation sites were also inaccessible for watering and required a high level of protection. Plantation sites infested with termites and invasive species like *Prosopis juliflora* (Vilayti Babool) were also found less suitable for plant growth, due to their impact on survival and growth of the plants. In addition to this, plantation sites in low-lying areas were observed as frost and drought-prone sites that cause high levels of damage to the plants and impact the survival of the plantation.

Figure 6 59: Highwayside plantations facing impacts of littering. Picture from PSR road (2019-2020 plantation)

Figure 6 60: Roadside plantations facing impacts of grazing and vandalism. Picture from RH railway line (2021-2022 plantation) and Nehrugarh to Surhali (2019-2020 plantation)

Although most of the sampled sites in Rewari division produced satisfactory survival, some of them were found to be impacted by heavy grazing, littering and abundance of invasive species. Plantation should be taken up only after the drivers of degradation have been controlled or adequate mitigation steps have been put in place. These site suitability factors are discussed in more detail below:

❖ Cattle Grazing

Cattle grazing is one of the major factors to be considered in an afforestation or reforestation project. Moderate to heavy grazing was observed in most of the plantation sites (Figure 6.61). Most of the cattle were feral cows migrated from Rajasthan, while some of them were domestic, that belong to the local villagers. Proper protection measure should be taken to prevent the plantation from the cattle.

Figure 6.61. Cattle grazing causing major destruction to the saplings in plantation site.

❖ Abundance of Invasive species

Another detrimental factor, that can cause serious damage to the plantation in the long run, is the presence of invasive species. In almost every sampled site in the Rewari forest division, presence of Invasive species was observed. The most detrimental was *Prosopis juliflora* (Figure 6.62), which impacts the soil quality and hampers plant growth. Most of the planted saplings under the canopy of *Prosopis* were found to be stunted, or dead. Apart from this other invasive species observed in the plantation sites are: *Parthenium hysterophorus* and *Argemone mexicana* (Figure 6.63). Post-plantation control of invasive species is needed to ensure the proper growth and survival of the plantation.

Figure 6.62: Abundance of Prosopis juliflora in the plantation sites impacting the site quality

Figure 6.63: Abundance of Argemone mexicana and Parthenium in the plantation sites

❖ Disturbances created by local community

Some plantation sites were severely impacted by the local community. This situation is common in the roadside plantations, where littering and garbage dumping by the local people is severely affecting the planted species (Figure 6.64). A large number of the saplings were also found to be destroyed, due to a land dispute between the villagers and the forest department. Proper awareness programs should be created by the FD to enhance the positive community participation and ensure the survival of the plantation. Proper monitoring is also required in these type of sites.

Figure 6.64: Garbage dumping in the plantation sites

6.6.1.2. Species Suitability

A total of 24 species of trees were recorded in the plantation sites of Rewari. Papdi (*Holoptelea integrifolia*), Sheesham (*Dalbergia sissoo*) and Neem (*Azadirachta indica*) were observed as the most commonly planted species, out of which Papdi and Sheesham showed excellent

adaptability to the sites, evident from its survival percentage and growth (Figure 6.65). The unpalatable and drought-tolerant characteristics of Papdi makes it extremely suitable for the landscape. However, a large proportion of Neem plants succumbed to the impacts of frost and cattle grazing. The selected species are native to the region and can perform better through improved maintenance and protection measures.

- Apart from these, fast-growing species like Bakain (*Melia azadirach*), Balamkheera (*Kigelia pinnata*) and Badam papdi (*Pongamia pinnata*) were also used in plantations that showed good growth rate and survival.

Figure 6.65: Fast-growing species like Balamkheera, Bakain and Sheesham from 2020-2021, 2019-2020, and 2021-2022 plantation years respectively

- Species like Siris (*Albizia procera*), Arjun (*Terminalia arjuna*), and Lasoda (*Cordia myxa*) were planted in a few places that showed less survival and growth rates, due to shortage of water, impacts of overgrazing and extreme weather conditions in summer and winter.
- Other native species like Belpatra (*Aegle marmelos*), Shahtoot (*Morus alba*), Jamun (*Syzygium cumini*), Kachnar (*Bauhinia purpurea*), Kadam (*Neolamarckia cadamba*), Van Kadam (*Mitragyna parvifolia*), Peepal (*Ficus religiosa*), Badh (*Ficus benghalensis*), Raintree (*Albizia saman*), etc. were planted on isolated occasions in a limited number of plantation sites where they showed good growth and survival in presence of adequate water availability and protection measures.
- Some native species like Jand (*Prosopis cineraria*), Reonjh (*Acacia leucophloea*), Babool (*Acacia nilotica*), Khair (Acacia catechu), Khair (*Acacia catechu*), and Jaal (*Salvadora oleoides*) are suitable for the arid landscape and are recommended to be planted in the drier parts of the Rewari Forest Division.

Table 6.53: List of planted species observed in Rewari Division

Sl. No	Species planted	
	Common name	Scientific name
1	Papdi	*Holoptelea integrifolia*
2	Neem	*Azadirachta indica*
3	Sheesham	*Dalbergia sissoo*
4	Balamkheera	*Kigelia pinnata*
5	Bakain	*Melia azadirach*
6	Siris	*Albizia procera*
7	Arjun	*Terminalia arjuna*
8	Badampapdi	*Pongamia pinnata*
9	Lasoda	*Cordia myxa*
10	Bel	*Aegle marmelos*
11	Kachnar	*Bauhinia purpurea*
12	Peepal	*Ficus religiosa*
13	Imli	*Tamarindus indica*
14	Jacaranda	*Jacaranda mimosifolia*
15	Jamun	*Syzygium cumini*
16	Kadam	*Neolamarckia cadamba*
17	Van kadam	*Mitragyna parvifolia*
18	Sehjan	*Moringa oleifera*
19	Badh	*Ficus benghalensis*
20	Raintree	*Albizia saman*
21	Shahtoot	*Morus alba*
22	Silver oak	*Grewia robusta*
23	Pilkhan	*Ficus virens*

6.6.2. Effectiveness

6.6.2.1. Survival

The overall survival of the plantations evaluated in the Rewari division was found to be 80.79% which is a good survival rate for this region. The highest and lowest survival rate was recorded in the plantations carried out in 2021-2022: 92% and 63% respectively. Among the three plantation years highest survival percentage was observed in the plantations established during the year 2021-22 followed by plantations established in the years 2020-21 and 2019-20 respectively (Table 6.54)

Table 6.54: Year-wise average survival rate and average height

Year	Survival %	Average Height (Ft.)
2019-2020	79.38	10.15
2020-2021	77.99	9.51
2021-2022	82.43	6.77

6.6.2.2 Growth of the planted species

A total of 23 planted species were found in the plantations of Rewari division. Papdi (Holoptelea integrifolia) was found to be the most planted species, followed by Neem (Azadirachta indica) and Sheesham (Dalbergia sissoo). The fast growing species like Balamkheera, Bakain and Sheesham attained maximum height among all the planted species in all the plantation years (Table 6.55 & Figure 6.66). The growth of Papdi was observed as slow and attained a maximum average height of 10.4 ft after 3 years. The stunted growth in Papdi, Neem and few other species is due to inadequate watering and die-back due to extreme climatic conditions while some species failed to attain appropriate height due to grazing and human disturbances.

Table 6.55: Year-wise average height of the planted species in evaluated sites

Sl. No	Species planted		Height (ft.)		
	Common name	Scientific name	2019-2020	2020-2021	2021-2022
1	Papdi	*Holoptelea integrifolia*	10.4	6.5	4.5
2	Neem	*Azadirachta indica*	8		6
3	Sheesham	*Dalbergia sissoo*	15.8	12	6
4	Balamkheera	*Kigelia pinnata*	16	12	8
5	Bakain	*Melia azadirach*	16.2		
6	Siris	*Albizia procera*	10	9.5	6
7	Arjun	*Terminalia arjuna*	-	7	5
8	Badampapdi	*Pongamia pinnata*		6.8	6
9	Lasoda	*Cordia myxa*	8	9.2	
10	Bel	*Aegle marmelos*			3.9
11	Kachnar	*Bauhinia purpurea*		10	
12	Peepal	*Ficus religiosa*		5.5	
13	Imli	*Tamarindus indica*		10	
14	Jacaranda	*Jacaranda mimosifolia*		12.1	
15	Jamun	*Syzygium cumini*		11.5	
16	Kadam	*Neolamarckia cadamba*		11.5	
17	Van kadam	*Mitragyna parvifolia*		10.1	
18	Sehjan	*Moringa oleifera*		10	
19	Badh	*Ficus benghalensis*		7	
20	Raintree	*Albizia saman*			5
21	Shahtoot	*Morus alba*	12	15	
22	Silver oak	*Grewia robusta*		11	
23	Pilkhan	*Ficus virens*		11.5	
		Average	**12.05**	**9.90**	**5.6**

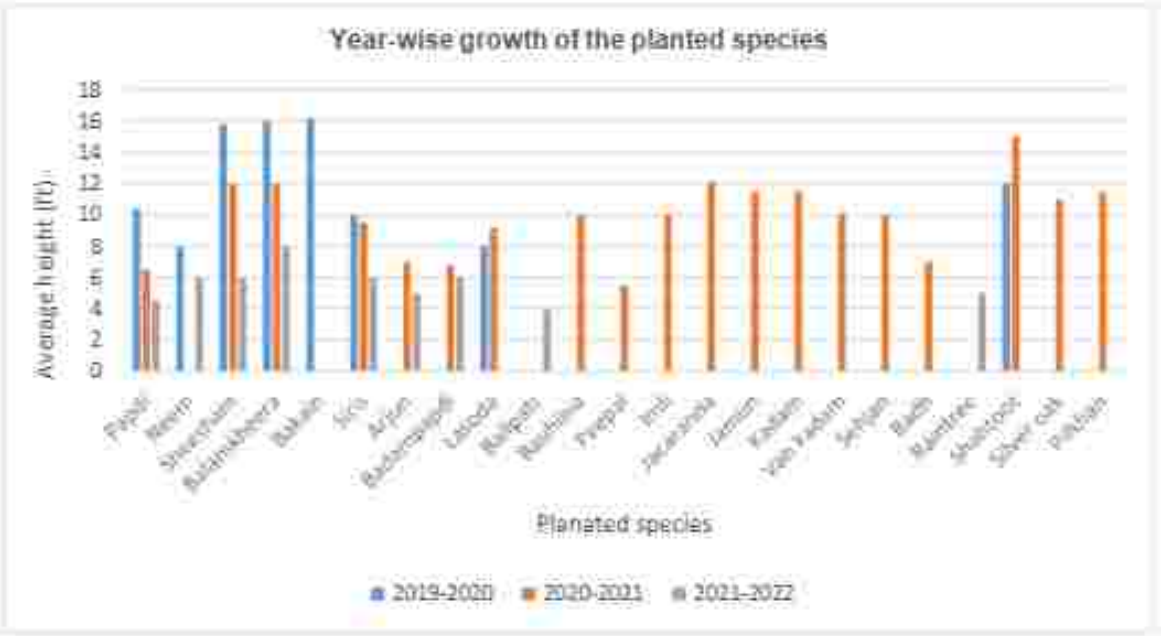

Figure 6.66: Graph showing the average height of the planted species in different plantation in 3 years

6.6.3. Sustainability

6.6.3.1 Protection

No permanent protection measures were observed in the plantation sites that were evaluated except for three sites, where barbed-wire fencing was done (Figure 6.67). However, 19 out of 21 sites reported that temporary brushwood fencing has been used in the initial stages of plantation, to protect the sapling from cattle grazing. Additionally, a unique traditional method known as Chapa binding was used in some plantation sites to protect the saplings from the impacts of frost. This practice includes covering the plant with Saccharum straws and is mostly carried out due to individual efforts and the personal interest of the forest guard.

Figure 6.67: Barbed-wire fencing in Masani Bandh Plantation site

6.6.3.2. Monitoring

As discussed in the previous section, a majority of the plantation sites in Rewari lack deployment of permanent protection measures, resulting in only one form of protection and monitoring i.e. through watcher/chowkidar, appointed by the Forest Department on a contractual basis from the neighboring villages. However, the appointed watch is inadequate for monitoring the assigned area which is often a huge plantation site or more than one plantation site.

Figure 6.68: Chowkidars in their respective plantation sites: Didoli Sec. 4-5 and Jhabua district

6.6.3.3. Maintenance

The written information/evidence/records for maintenance/replacement of plants such as plantation journals, APOs, plantation maps etc., have not been maintained in most of the sites. This is one of the major shortcomings seen across the ranges of the Rewari division.

6.6.4. Scoring of the plantation works by the third party

The plantations carried out under the CAMPA scheme in the years 2019-20, 2020-21 and 2021-22 scored an average of 188.45, out of 250 (Table 6.56). Overall, the score obtained was good, considering the water-scarce rocky terrain and severe anthropogenic disturbances observed in most of the plantation sites.

Table 6.56: Score obtained by the plantations in Rewari division

Sr.	Components	Full score	Obtained Score
1	Survival	100	80.79
2	Growth	20	18.33
3	Species suitability	10	9.81
4	Site suitability	10	9.43
5	Protection	20	6.95
6	Extent	20	10.00
7	Journal	20	9.29
8	Map	10	9.43
9	Invasive	10	7.62
10	Species composition	10	10.00
11	Weeding and hoeing	10	8.95
12	Watch and ward	10	7.86
TOTAL		250	188.46

6.6.5. Non-plantation activities

6.6.5.1. Soil and Moisture Conservation (SMC) Measures

One recharge trench was evaluated under this category. The trench was intact and well maintained (Figure 6.69), except for some patches where littering and weed growth were observed. The structure was found to be working satisfactorily.

Table 6.57: Details of evaluated SMC site of Rewari division

Year	Range	Site Name	Name of SMC work	No. of work	Size as per measurement book	Actual Size	Expenditure
2021-22	Rewari	Masani Recharge Trench	Recharge Trench	1No	NA	1.5×1.5×1300 m	1,68,255

Figure 6.69: Recharge Trench for Soil Moisture Conservation in Masani bandh, Rewari range

6.6.5.2. Fencing

One Barbed wire fencing was evaluated under this category. 90% of the fencing was found intact, while the 10% damage was due to cattle and human encroachment (Figure 6.70). The effectiveness of the plantation was observed to be moderate.

Table 6.58: Details of evaluated fencing site of Rewari division

Year	Range	Barbed wire Fence Id/NO/Name	Length in measurement Book	Actual Length in Field	%Variation (+/-)	Present status	Effectiveness of the Fence
2021-22	Rewari	Hoda-by-pass	8 RKM	8 RKM	0	Intact	Effective

Figure 6.70: Barbed Wire fencing in Huda-by pass (2021-2022) Rewari range

6.6.5.3. Civil Works

Two building operations were evaluated under this category. The buildings were constructed and maintained properly (Figures 6.71 & 6.72). The present condition of these buildings was found to be very good.

Table 6.59: Evaluated Fencing site of Rewari division

	Year	Range	Site Name	Civil Work category	No. of work	Expenditure	Condition
1	2021-22	Rewari	Upward DFO office-1st Floor (Range Office- Rewari)	Building	1No	63,84,800	Very good
2	2021-22	Rewari	Upward DFO office-1st Floor (Range Office-M&E)	Building	1No		Very good

Figure 6.71: Building constructed for Rewari Range Office in Rewari range

Figure 6.72: Building constructed for Range Office (M&E) in Rewari range

6.6.6. Scoring of the Non-Plantation Activities

Table 6.60: Score obtained by the SMC sites in Rewari division

	Scoring components	Full score	Obtained score
1	Working status	20	20
2	Site suitability	20	20
3	Measurement as per the APO	20	20
4	Fulfilling design specification	20	20
5	Measurement book	20	0
	TOTAL	**100**	**80**

Table 6.61: Score obtained by the fencing sites in Rewari division

	Scoring components	Full score	Obtained score
1	Working Status	20	20
2	Serving the purpose intended	20	20
3	Actual extent	20	20
4	Site suitability	10	10
5	Measurement book	10	10
6	Expenditure as per the APO	20	20
	TOTAL	**100**	**100**

Success Story: Pali Section 38- Rewari range

This Plantation site demonstrates an excellent example of community based conservation. The plantation site is co-managed by a group of youth from the village Pali led by a Retired BSF officer Mr. Ramesh Kumar. The team "Green Club-Pali" with support from the Forest officer Mr. Rahul Singh have installed a drip irrigation system for watering the saplings in the initial states. Apart from this, the team spreads awareness on the benefits of plantation and about environmental issues amongst the villagers. This has led to further support from the villagers in terms of providing water from tube wells and protecting the trees. This site also has a permanent watcher employed who has been protecting the 21.72 ha planation site from grazing despite lack of fencing or any other protection measures. The combined efforts of the forest department and the community has led to a successful survival rate of 85.2% in the plantation.

Figure: The head of the Green club, Mr. Ramesh Kumar who has led the youth group in Pali Village

Figure:1) Drip irrigation system was installed by the Green club, Pali Village; 2) Maintained plantation of Sheesham in Pali Section 38

Success Stories: JLN Canal- Bawal range

This Plantation site demonstrates an excellent example of a diverse plantation site. The plantation site lies adjacent to the JLN Canal, which plays a vital role in achieving good survival rate (84.8%). However, the highlight of the site is a CAMPA Nursery that lies within the site and has carried out a successful demonstration of more than 31 plant species in a plantation site. Like majority of the planation sites, this site lacks basic protection measures like fencing and a watcher, yet the Nursery chowkidar along with support from Forest officers, Mr. Mohit and Mr. Ajay have effectively managed and maintained the 25 RKM site. Some parts of the planation site also form a small wetland that attract wild animals and several migratory birds, thus contributing in enhancing the biodiversity of the region.

Figure: 1) 2) Plantation of Papdi along JLN canal; 3) CAMPA Nursery located along JLN canal plantation site; 4) Presence of wildlife and migratory birds in the wetland near plantation site

7. Chapter 7- Central Circle

The Central circle consists of five divisions, e.g. Jhajjar, Karnal, Panipat, Rohtak and Sonipat. Each and every division is unique in terms of the terrain, local vegetation, drivers of degradation, and results produced. The findings are categorized into three dimensions: Relevance, Effectiveness and Sustainability by measuring five principal variables namely site suitability, species selection, growth, survival and sustainability.

Table 7.1: Plantation target and achievement under CATP and NPVTP for 2019-20

Division	CATP			NPVTP		
	Target (Ha)	Achieved (Ha)	Plants	Target (RKM)	Achieved (RKM)	Plants
Karnal	36.45	42.537	42537	95	95	22250
Panipat	47.691	22.3	22309	60	60	15000
Sonepat	1.17	1170	1170	60	60	15000
Rohtak	12.03	12033	12033	60	60	15000
Jhajjar	0.68	680	680	60	60	15000

Table 7.2: Plantation target and achievement under CATP and NPVTP for 2020-21

Divisions	CA TP			NPV TP		
	Target (Ha)	Achieved (Ha)	Plants	Target (RKM)	Achieved (RKM)	Plants
Karnal	87.12	87.12	87120	250	250	62500
Panipat	45.29	20.3	20300	100	100	25000
Sonepat	8.93	8.93	8930	100	100	25000
Rohtak	0	0	0	100	100	25000
Jhajjar	0	0	0	50	50	12500

Table 7.3: Plantation target and achievement under NPV RIDGE

Divisions	NPV RIDGE		
	Target (RKM)	Achieved (RKM)	Plants
Karnal	100	90	45000

Panipat	50	50	25000
Sonepat	50	50	25000
Rohtak	0	0	0
Jhajjar	15	10.3	5150

Table 7.4: Plantation target and achievement under CATP and NPVTP for 2021-22

Divisions	CATP			NPVTP		
	Target (Ha)	Achieved (Ha)	Plants	Target (RKM)	Achieved (RKM)	Plants
Karnal	108.899	108.899	108899	316	316	79000
Panipat	24.988	24.988	24988	100	100	25000
Sonepat	0	0	0	190	190	47500
Rohtak	0.428	0.428	428	100	100	25000
Jhajjar	2.415	2.415	2415	100	100	25000

Table 7.5: Plantation target and achievement under NPV RIDGE and NPV ALKALI for 2021-22

Divisions	NPV RIDGE			NPV ALKALI		
	Target (RKM)	Achieved (RKM)	Plants	Target (RKM)	Achieved (RKM)	Plants
Karnal	150	150	64475	0	0	0
Panipat	90	90	45000	0	0	0
Sonepat	130	130	65000	0	0	0
Rohtak	30	30	9900	25	25	25000
Jhajjar	0	0	0	0	0	0

7.1 JHAJJAR DIVISION

Table 7.6: List of CA (Compensatory Afforestation) plantation activities evaluated in the Jhajjar division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
2019-20	Jhajjar	Jhajjar West	CA TP	Birdhana Minor (Dujana Chara road pull to Tall)	0.68 Ha	0.68 Ha	680	680	360	52.9	6.7	09-05-2023
2021-22	B_garh	B_garh west	CA TP	GWS canal km 255.6	1.243 ha	1.243 ha	1243	1243	345	27.8	3.3	12-05-2023

Table 7.7: List of NPV (Net Present Value) plantation activities evaluated in the Jhajjar division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
2019-20												
2019-20	Matanhail	Subana	NPV TP	Kashri minor	7 RKM	7 RKM	1750	1750	1289	73.1	3.8	10-05-2023
2019-20	B_garh	B_garh west	NPV TP	Chhara to chhochhi road	4 RKM	4 RKM	1000	1000	610	61.0	4.8	11-05-2023
2019-20	B_gar	Badli	NPV TP	Noona majra road to shahpur and deslpur to daboda khurd	4 RKM	4 RKM	1000	1000	772	77.2	4.3	11-05-2023
2019-20	Jhajjar	Machhroli	NPV TP	Luhari Minor	10 RKM	10 RKM	2500	2500	556	22.2	5.7	09-05-2023
2019-20	Jhajjar	Jhajjar East	NPV TP	Gurgaon Road to Silana Road and Silana to Nawabi Road	5 RKM	5 RKM	1250	1250	1062	85.0	13.5	09-05-2023
2020-21												

2020-21	Jhajjar	Jhajjar East	NPV TP	Jahangirpur Minor RD - Suhra pull to Bamdola	5 RKM	5 RKM	1250	1250	872	69.8	4	09-05-2023
2020-21	Matanhail	Khanpur	NPV TP	Sasroli to Dadri road km 0 to 6 L&R	7 RKM	7 RKM	1750	1750	1140	65.1	6.3	10-05-2023
2020-21	Matanhail	Subana	NPV RIDGE	Sajhajapur village	8.5 RKM	8.5 RKM	17000	17000	13655	80.3	20	11-05-2023
2020-21	B_gar	Badli	NPV TP	Dansa minor rd 5 to 25 L & R	11 RKM	11 RKM	2750	2750	2140	77.8	7.2	12-05-2023
2020-21	B_garh	B_garh west	NPV RIDGE	Ismaila Distributri RD 6 to tail L& R	5 RKM	5 RKM	1650	1650	1236	74.9	6.32	11-05-2023
2020-21	B_garh	B_garh	NPV RIDGE	HSIIDC sec 17	4.30 RKM	4.30 RKM	2150	2150	1750	81.4	10.5	12-05-2023
2021-22												
2021-22	Jhajjar	Machhroli	NPV TP	NH-71 Km 401 to 407 L&R	4 RKM	4 RKM	1000	1000	780	78.0	5.5	09-05-2023
2021-22	Jhajjar	Jhajjar East	NPV TP	Suhra to Ladpur Road	6 RKM	6 RKM	1500	1500	720	48.0	5	09-05-2023
2021-22	Matanhail	Subana	NPV TP	Raiya rest house Road km 0 to 5	6 RKM	6 RKM	1500	1500	1180	78.7	4	10-05-2023
2021-22	Matanhail	Subana	NPV TP	Jatwara to Amboli road km 0 to 4	8 RKM	8 RKM	2000	2000	1790	89.5	4.1	10-05-2023
2021-22	Matanhail	Khanpur	NPV TP	Patuwas Distributri RD 2200- to- 61000	18 RKM	18 RKM	4500	4500	2748	61.1	6.8	10-05-2023

7.1.1. Relevance

7.1.1.1 Site suitability

- Plantations along the canal/distributaries have performed well

Due to the availability of moisture year-round, the plantations along the canals showed impressive survival and growth. Mostly Sheesham, Bakain, Arjun, and Papdi were planted in these areas and all of them showed good results (Figure 7.1).

Figure 7.1. Plantation along the Ismaila Distributary in Bahadurgarh shows good growth of Sheesham

- NPV-Ridge plantations have performed well

Plantations carried out on ridges have produced excellent survival and growth (Figure 7.2). The furrows retain moisture during summer which ensures the success of the plantation. With fast-growing species like Sheesham, Kikar, these kinds of plantations should be encouraged and practiced more.

Figure 7.2: Eucalyptus Plantation on Ridge under NPV-Ridge component in Matsinhal Range

- Impact of agricultural burning

In some sites, plants were found to be severely damaged due to the stubble burning on the adjacent agricultural fields (Figure 7.3). Proper fire lines should be made to keep the fire away from the plantations. Consultation with the local landowners is required before the afforestation initiative to secure the survival of the planted species.

Figure 7.3: Stubble burning in the adjacent field in Nana Majra plantation site

7.1.1.2. Species suitability

Papdi (*Holoptelia intigrifolia*), Sheesham (*Dalbergia Sissoo*), Arjun (*Terminalia Arjuna*), and Bakain (*Melia azadirach*) are the predominant plant species planted in Jhajjar division. These species exhibit excellent adaptability to local conditions and demonstrate a higher survival rate

across various sites, including roadsides, along the canal/s, and near agricultural fields.

Table 7.8: Planted species in the plantations of Jhajjar division

Sr. No.	Local Name	Botanical Name
1	Papdi	*Holoptelea integrifolia*
2	Sheesham	*Dalbergia sisoo*
3	Bakain	*Melia azedarach*
4	Arjun	*Terminalia arjuna*
5	Siris	*Albizia lebback*
6	Neem	*Azadirachta indica*
7	Safeda	*Eucalyptus sp.*
8	Jamun	*Syzygium cumini*
9	Bottlebrush	*Callistemon lanceolatus*
10	Dalmoth	*Acacia auricularis*
11	Kikar	*Acacia nilotica*
12	Peepal	*Ficus religiosa*
13	Jamoa	*Eugenia cuspidate*
14	Balamkheera	*Kigelia pinnata*

7.1.2. Effectiveness

7.1.2.1. Survival of the plantation

The average survival rate of plantations in the Jhajjar division stands at 66.87%, indicating room for improvement. Among three plantation years, the highest survival rate (74.9%) was observed in plantations established during 2020-21, while the lowest rate (61.91%) was recorded in the 2019-20 plantations (Table 7.9).

Table 7.9: Year-wise survival rate and growth of the plantation sites

Year	Av. Survival (%)	Av. Height (ft.)
2019-20	61.9	6.4
2020-21	74.9	7.3
2021-22	63.8	4.9

7.1.2.2. Growth of the plantation

Among the 14 planted species, Siris, Safeda and Balamkheera have attained the most height. Bakain, Jamun, Sheesham, and Jamoa have also attained impressive heights in most plantations (Table 7.10 & Figure 7.4).

Table 7.10: The average height of different plant species across three plantation years

Planted species		Plantation year		
Local Name	**Botanical Name**	**2019-20**	**2020-21**	**2021-22**
Papdi	*Holoptelea integrifolia*	5.3	5.1	4.5
Sheesham	*Dalbergia sisoo*	6.9	7.6	4.5
Bakain	*Melia azadarach*	7.2	6.3	4.7
Arjun	*Terminalia arjuna*	5.0	6	3.75
Siris	*Albizia lebback*	8.2	-	5.25
Neem	*Azadirachta indica*	6.0	-	4
Safeda	*Eucalyptus sp.*	-	19.5	-
Jamun	*Syzygium cumini*	-	8	4.5
Bottlebrush	*Callistemon lanceolatus*	-	6	4
Dalmoth	*Acacia auriculariis*	-	5	-
Kikar	*Acacia nilotica*	-	2	-
Peepal	*Ficus religiosa*	-	-	6
Jamoa	*Eugenia cuspidata*	-	-	6
Balamkheera	*Kigelia pinnata*	-	-	7

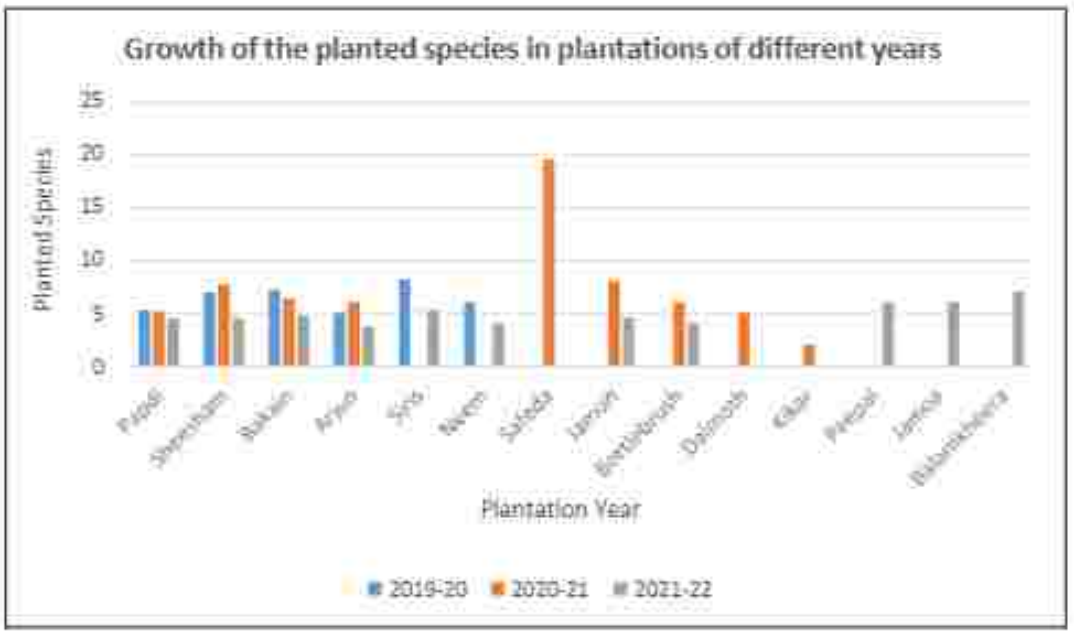

Figure 7.4: Average height of different plant species across three evaluation years

7.1.3. Sustainability

7.1.3.1 Protection

The plantation sites are without proper protection measures such as fencing, tree guards, cattle-proof trenches etc., making these plantation sites prone to the damage inflicted by grazing and browsing animals. Appropriate protection measures should be taken before conducting plantation activities to avoid damage to the plantation by grazing animals, trespassers, and unauthorized harvesting.

7.1.3.2 Maintenance

The written information/evidence/records for maintenance/replacement of plants such as plantation journals, APOs, plantation maps, etc., have not been maintained in any forest range. This is one of the major shortcomings seen across the ranges of Jhajjar division.

7.1.3.3 Monitoring

Regular monitoring was observed in all the plantation sites of the Jhajjar division. Chowkidaar/watchers have been appointed in all the forest ranges to take care of plantation sites.

7.1.4. Scoring of the plantations

The plantations carried out under the CAMPA scheme in the Jhajjar division in the year 2019-20, 2020-21 and 2021-22 scored an average of 123.5, out of 250 (Table 7.11). Overall, the score obtained was satisfactory, considering the water-scarce area, grazing pressure, and severe anthropogenic disturbances observed in most of the plantation sites.

Table 7.11: Average height of different plant species across three evaluation years

Year	Range	Plantation Site	Survival	Growth	Species suitability	Site suitability	Protection	Extent	Journal	Map	Invasive	Species composition	Weeding and hoeing	Watch and ward
2019-20	Matanhail	Kashni minor	73.1	15.0	10	10	0	10	0	0	10	10	10	10
2019-20	B_garh	Chhara to chhochhi road	61.0	16.0	10	10	0	10	0	0	10	10	10	10
2019-20	B_gar	Noona majra road to shahpur and deslpur to daboda khurd	77.2	17.0	10	10	0	10	0	0	0	10	0	10
2019-20	Jhajjar	Luhari Minor	22.2	15.0	10	10	0	10	0	0	10	10	10	10
2019-20	Jhajjar	Gurgaon Road to Silana Road and Silana to Nawabi Road	85.0	20.0	10	10	0	10	0	0	10	10	10	10
2019-20	Jhajjar	Birdhana Minor (Dujana Chara road pull to Tall)	52.9	17.0	10	10	0	10	0	0	10	10	10	10
2020-21	Jhajjar	Jahangirpur Minor RD - Suhra pull to Bamdola	69.8	16	10	10	0	10	0	0	10	10	10	10
2020-21	Matanhail	Sasroli to Dadri road km 0 to 6 L&R	65.1	17	10	10	0	10	0	0	10	10	10	10
2020-21	Matanhail	Sajhajapur village	80.3	20	10	10	0	10	0	0	10	10	10	10
2020-21	B_gar	Dansa minor rd 5 to 25 L & R	77.8	19	10	10	0	10	0	0	10	10	10	10
2020-21	B_garh	Ismaila Distributri RD 6 to tail L& R	74.9	18	10	10	0	10	0	0	10	10	10	10
2020-21	B_garh	HSIIDC sec 17	81.4	20	10	10	0	10	0	0	10	10	10	10
2021-22	Jhajjar	NH-71 Km 401 to 407 L&R	78.0	20	10	10	0	10	0	0	0	10	0	10
2021-22	Jhajjar	Suhra to Ladpur Road	48.0	18	10	10	0	10	0	0	10	10	10	10
2021-22	Matanhail	Raiya rest house Road km 0 to 5	78.7	17	10	10	0	10	0	0	10	10	10	10

2021-22	Matanhail	Jatwara to Amboli road km 0 to 4	89.5	17.0	10	10	0	10	0	0	10	10	10	10
2021-22	Matanhail	Patuwas Distributri RD 2200-to-61000	61.1	18.0	10	10	0	10	0	0	5	10	5	10
2021-22	B_garh	GWS canal km 255.6	27.8	15.0	10	10	0	10	0	0	10	10	10	10
		Average	**66.9**	**17.5**	**10**	**10**	**0**	**10**	**0**	**0**	**8.6**	**10**	**8.6**	**10**

7.1.5. Non- Plantation Activities:

7.1.5.1. Civil Works (Buildings)

Table 7.12: Civil Works sites evaluated in Jhajjar Division

S.No.	Year	Range	Component	Name of Site	Expenditure	Description
1.	2020-21	B.Garh	Building (Guard Hut)	HSIIDC Sec-16	10,00,000	The constructed building is in good condition, free from cracks, and damage, and fully compliant with the required standards.
2.	2020-21	Matanhail	Building (Forester Quarter)	Sahlawas	12,67,920	

Figure 7.5: Forester quarter in Matanhill Range and Guard Hut in Bahadurgarh Range

7.1.5.2. Effectiveness of the Civil Works (Building)

All the building works were found effective and compliant with the required standards.

Table 7.13: Effectiveness of Civil Works

Sr. No.	Components	Effectiveness
1	Site Location	Good
2	Serving the intended purpose	Good
3	Structurally sound and free of cracks	Good
4	Free of dampness and leakage	Good
5	Overall finish and look	Good

7.2 PANIPAT DIVISION

Table 7.14: Plantation sites (CA) evaluated in Panipat division

YEAR	Component	Range	Block	Name of Plantation Site	Area (As per APO)		Actual Area	Target	Total plants planted	Total plants counted	Survival (%)	Av. Height (ft.)	Evaluation month
					Ha	RKM							
2019-20													
2019-20	CA TP	Samalkha	Samalkha west	DUK railway line 65-80 L& R side	5 Ha		5 ha	5000	5000	2800	56.0	4.6	April-May, 2023
2019-20	CA TP	Panipat	Matlauda	JPR railway line	4 Ha		4 ha	4000	4000	1473	36.8	8.7	April-May, 2023
2019-20	CA TP	Panipat	Panipat	Nohra drain RD 0-43	1 Ha		1 ha	1000	1000	608	60.8	7.6	April-May, 2023
2019-20	CA TP	Panipat	Panipat	Jattal drain	1 Ha		1 ha	1000	1000	114	11.4	6.5	April-May, 2023
2019-20	CA TP	Samalkha	Bapoli	Drain No. 2 RD 135-150 L&R	3 Ha		3ha	3000	3000	1688	56.3	5.6	April-May, 2023
2020-21													
2020-21	CA TP	Samalkha	Bapoli	Drain no. 2 village babail to village khojkipur	20.3 Ha		20.5 Ha	20300	7800	5726	73.4	9.6	April-May, 2023
2020-21	CA TP	Smalkha	Bapoli	Yamuna bundh					12500	7625	61.0	6.3	April-May, 2023
2021-22													
2021-22	CA TP	Panipat	Madlauda	Village Assan	2 Ha		2ha	2000	2000	1523	76.2	2.8	April-May, 2023
2021-22	CA TP	Panipat	Matlauda	Nayi Nala drain	5 Ha		3.5 ha	5000	3500	3100	88.6	7.1	April-May, 2023
2021-22	CA TP	Panipat	Matlauda	Old Badshai canal	1.48 Ha		1.4 ha	1480	1488	979	65.8	4.1	April-May, 2023
2021-22	CA TP	Panipat	Matlauda	Madlauda minor	2.13 Ha		3.15 RKM	2140	2135	1611	75.5	8.0	April-May, 2023
2021-22	CA TP	Panipat	Madlauda	Gohana distributry		17 RKM	17 RKM	5000	5000	2200	44.0	4.5	April-May, 2023
2021-22	CA TP	Samalkha	Bapoli	Panipat drain no. 1	3Ha		3 ha	3000	3000	1928	64.3	5.8	April-May, 2023
2021-22	CA TP	Samalkha	Bapoli	Yamuna bundh (Rana Majra)	1 Ha		1ha	1000	1000	899	89.9	7.3	April-May, 2023
2021-22	CA TP	Samalkha	Samalkha west	Narayana a minor RD 12 to 42 L & R	1 Ha		1 ha	1000	1000	820	82.0	120	April-May, 2023
2021-22	CA TP	Panipat	Madlauda	Gangesar minor 0-20	4.5 Ha		2.5 ha	4500	4500	1485	33.0	4.3	April-May, 2023

Table 7.15: Plantation sites (NPV) evaluated in Panipat division

YEAR	Component	Range	Block	Name of Plantation Site	Area (As per APO)		Actual Area	Target	Total plants planted	Total plants counted	Survival (%)	Av. Height (ft.)	Evaluation month
					Ha	RKM							
2019-20													
2019-20	NPV TP	Panipat	Panipat	DUK Railway Line		6 RKM	6 RKM	1500	1500	571	38.1	9.5	April-May, 2023
2019-20	NPV TP	Panipat	Israna	Jaondhan Kalan to Karad Road		4 RKM	4 RKM	1000	1000	276	27.6	9.5	April-May, 2023
2019-20	NPV TP	Panipat	Madlauda	Butana Branch		6 RKM	6 RKM	1500	1500	1015	67.7	8.5	April-May, 2023
2019-20	NPV TP	Samalkha	Bapoli	Mohali to Kurad		6 RKM	6 RKM	1500	1500	1164	77.6	5.3	April-May, 2023
2019-20	NPV TP	Samalkha	Samalkha west	Dhindar to Bali road L & R		5.5 RKM	5.5 RKM	1375	1375	1160	85.8	11.1	April-May, 2023
2019-20	NPV TP	Samalkha	Samalkha west	Chulkana to Patrikalyana Road		4.5 RKM	4.5 RKM	1125	1125	920	81.8	14.3	April-May, 2023
2020-21													
2020-21	NPV RIDGE	Panipat	Panipat	Drain No. 2, Bajida Distry Pul to RD 45 L/Side		5 RKM	5 RKM	2500	2500	1813	72.5	18.3	April-May, 2023
2020-21	NPV RIDGE	Samalkha	Samalkha East	Drain No. 2 RD 187 to 204		16 RKM	16 RKM	8000	8000	4800	60.0	21.0	April-May, 2023
2020-21	NPV RIDGE	Panipat	Madlauda	Hansi branch		20 RKM	20 RKM	10000	10000	7380	73.8	18.8	April-May, 2023
2020-21	NPV TP	Panipat	Matlauda	Panipat to Bhandari road		10 RKM	10 RKM	2500	2500	955	38.2	5.0	April-May, 2023
2020-21	NPV TP	Panipat	Panipat	Ahulana minor		10 RKM	10 RKM	2500	2500	789	31.6	6.7	April-May, 2023
2020-21	NPV TP	Panipat	Israna	Uriana minor		8 RKM	8 RKM	2000	2000	1861	93.1	5.7	April-May, 2023
2020-21	NPV TP	Samalkha	Manana	Samarkha to narayana road		4 RKM	4 RKM	1000	1000	380	38.0	4.1	April-May, 2023
2020-21	NPV TP	Samalkha	Samalkha East	Beholi to Passina road		8 RKM	8 RKM	2000	2000	750	37.5	7.0	April-May, 2023
2021-22													
2021-22	NPV RIDGE	Samalkha	Samalkha	Mahawati to Basada road		13 RKM	13 RKM	6500	6500	2692	41.4	16.7	April-May, 2023
2021-22	NPV TP	Panipat	Madlauda	Seenk to chichrana road		8 RKM	8 RKM	4000	2000	1048	52.4	4.6	April-May, 2023

2021-22	NPV TP	Panipat	Matlauda	Waiser to Alipur road	8 RKM	8 RKM	2000	2000	1749	87.5	4.1	April-May, 2023
2021-22	NPV TP	Panipat	Israna	Israna distributry	12 RKM	12 RKM	3000	3000	1940	64.7	5.6	April-May, 2023
2021-22	NPV TP	Panipat	Madlauda	Butana branch	6 RKM	6 RKM	1500	1500	1190	79.3	4.1	April-May, 2023
2021-22	NPV TP	Panipat	Israna	Israna distributry	8 RKM	8 RKM	2000	2000	1757	87.9	4.9	April-May, 2023

7.2.1. Relevance

7.2.1.1. Site suitability

- Plantations carried out along the canals and in the floodplains performed well

Plantations carried out along a canal/drain and in a floodplain have performed very well. Due to the presence of the waterbody, moisture is retained in the soil and the saplings have enough water. Most of these plantations were inaccessible for vehicle, so the grazing or any other anthropogenic pressure is almost absent. Arjun, Jamun, Sheesham, Jamoa, etc. which can grow in waterlogged conditions were planted to ensure the survival of the plantation. In the plantation of Nayi Nala (2020-21) drain and Matlauda Minor of Panipat range, excellent growth and survival were observed (Figure 7.6).

The plantation of Yamuna Bundh (Rana Majra) was carried out in the floodplains of Yamuna river (Figure 7.7). Only Sheesham and Jamoa were planted here, which can withstand month-long waterlogged conditions.

Figure 7.6: Sheesham trees planted along the canal showed good growth and survival in Matlauda Minor plantation site

Figure 7.7: Jamba and Shleesham plantation showed very good results in the plantation of Yamuna Bandh Rana Majra

- Plantations beside the agricultural field have performed well

The plantation sites which are located beside the agricultural fields have particularly performed well (Figure 7.8). This is because farmers apply fertilizers to their crops, which also benefit the planted saplings. The saplings also get a steady supply of water from the irrigated agricultural fields.

Figure 7.8: Saplings in the plantation of Drain no 1 of Panipat Range showed very good growth and survival

❖ Plantations are well maintained despite high grazing pressure

Most of the plantations were very well maintained and produced decent survival and growth despite having very high grazing pressure. The credit goes to the forest guards and watchers who look over the plantations and consult with the local people regularly, spreading awareness about the ecological importance of the plantations. Only in a few plantations like Jattal Drain (2019-20) Ahulana Minor (2020-21) and Jaondhan Kalan to Karond Road (2019-20) of Panipat Range, the saplings suffered from severe grazing and other anthropogenic disturbances (Figure 7.9).

Figure 7.9: Saplings of Jattal Drain plantation showed poor survival due to grazing/Saplings of Ahulana Minor showed stunted saplings of Balamkheera due to grazing

❖ Sapling were affected due to stubble burning

Farmers in this area burn their crops after harvest to clear the land for the next season (Figure 7.10). This practice of stubble burnings are affecting the plantation. Proper consultation needs to be done with the local landowners before plantation to prevent the loss of saplings due to stubble burning.

In Samhalkha Range of Panipat division, the Range Officer Mr. Virender proactively approached the local communities and consult with them regarding the species and site selection. He also requests them to occasionally irrigate the plantations and explain them the importance of the afforestation project. He also organized multiple awareness programs in every village. As a result, the damages to the plantation caused by grazing and agricultural burning has reduced significantly.

Figure 7.10: Saplings were found to be affected due to stubble burning in Mattauda Minor (2021-22), Panipat Range

7.2.1.2 Species Suitability

- A total of 25 planted species was found in the plantation sites of Panipat division (Table 7.16).
- Fast growing species like Sheesham, Jamoa, Balamkheera were the most planted.
- Amaltas, Kikar and Safeda attained the highest height among all the planted species
- Due to the demand of the local communities, fruit-bearing species like Amrud, Jamun, Amla and Bel were also planted in some sites.
- Exotic species such as Safeda, Bottle Brush and Sliver Oak were planted in some plantation sites. Although these species produced good growth and survival, it is strongly suggested that exotic species should be excluded from the plantation species mix.

Table 7.16: Planted species in Panipat Division

Sl. No.	Planted species	
	Local name	Botanical name
1	Alstonia	Alstonia scholaris
2	Amaltas	Cassia fistula
3	Amla	Phyllanthus emblica
4	Amrud	Psidium guajava
5	Arjun	Terminalia arjuna

6	Bakain	Melia azadarach
7	Balamkheera	Kigelia pinnata
8	Bel	Aegle mermelos
9	Bottle Brush	Callistemon viminalis
10	Dalmoth	Acaia auriculiformis
11	Gamhar	Gmelina arborea
12	Jamoa	Eugeina jambolana
13	Jamun	Sygygium cumini
14	Kachnar	Bauhinia variegata
15	Kikar	Acacia nilotica
16	Lasoda	Cordia myxa
17	Neem	Azadirachta indica
18	Papdi	Holoptelea integrifolia
19	Pikhan	Ficus virens
20	Pipal	Ficus religiosa
21	Safeda	Eucalyptus babylonica
22	Shahtoot	Moras alba
23	Sheesham	Dalbergia sissoo
24	Silver Oak	Greville arobusta
25	Siris	Albizia procera

7.2.2. Effectiveness

7.2.2.1. Plant Survival

The overall survival rate of plantations in the Panipat division was found to be satisfactory at 60.7 %. Among the three plantation years, the highest survival rate was observed in the plantations carried out during 2021-22, with a rate of 66.8%. Conversely, the lowest survival rate was recorded for the plantations from 2019-20, with an average survival rate of 54.5% (Table 7.17).

Table 7.17: Average survival and growth of the plantation among three plantation years

Year	Survival %	Av. Height (ft.)
2019-20	54.5	7.1
2020-21	57.9	7.4
2021-22	66.8	5.5

7.2.2.2 Growth of the plantation

Amaltas, Kikar and Safeda were recorded as the highest-growing species in 2019-20, 2020-21 and 2021-22 respectively (Table 7.18 & Figure 7.11). Apart from these, Sheesham, Balamkheera and Papdi also attained good height.

Table 7.18: Average height of the planted species across three plantation years

Sl. No.	Planted species		Height of the saplings		
	Local name	Botanical name	2019-20	2020-21	2021-22
1	Alstonia	*Alstonia scholaris*	0	0	4.0
2	Amaltas	*Cassia fistula*	15.20	0	0
3	Amla	*Phyllanthus emblica*	4.00	0	5.1
4	Amrud	*Psidium guajava*	5.00	0	0
5	Arjun	*Terminalia arjuna*	5.25	5.0	3.9
6	Bakain	*Melia azadarach*	0	6.5	4.9
7	Balamkheera	*Kigelia pinnata*	7.13	8.3	6.0
8	Bel	*Aegle mermelos*	0	4.0	0
9	Bottle Brush	*Callistemon viminalis*	0	4.0	2.7
10	Dalmoth	*Acaia auriculiformis*	0	3.1	0
11	Gamhar	*Gmelina arborea*	5.00	0	0
12	Jamoa	*Eugeina jambolana*	7.43	6.1	5.8
13	Jamun	*Sygygium cumini*	5.80	7.4	6.5
14	Kachnar	*Bauhinia variegata*	3.30	0	0
15	Kikar	*Acacia nilotica*		14.8	0
16	Lasoda	*Cordia myxa*	6.80	3.9	0

17	Neem	*Azadirachta indica*	7.10	6.3	4.4
18	Papdi	*Holoptelea integrifolia*	6.41	6.0	4.2
19	Pikhan	*Ficus virens*	0	0	3.3
20	Pipal	*Ficus religiosa*	0	0	3.2
21	Safeda	*Eucalyptus babylonica*	0	21.8	16.7
22	Shahtoot	*Moras alba*	0	4.3	0
23	Sheesham	*Dalbergia sissoo*	9.62	9.1	6.9
24	Silver Oak	*Greville arobusta*	0	8.9	0
25	Siris	*Albizia procera*	0	0	5.1
			6.77	7.5	5.5

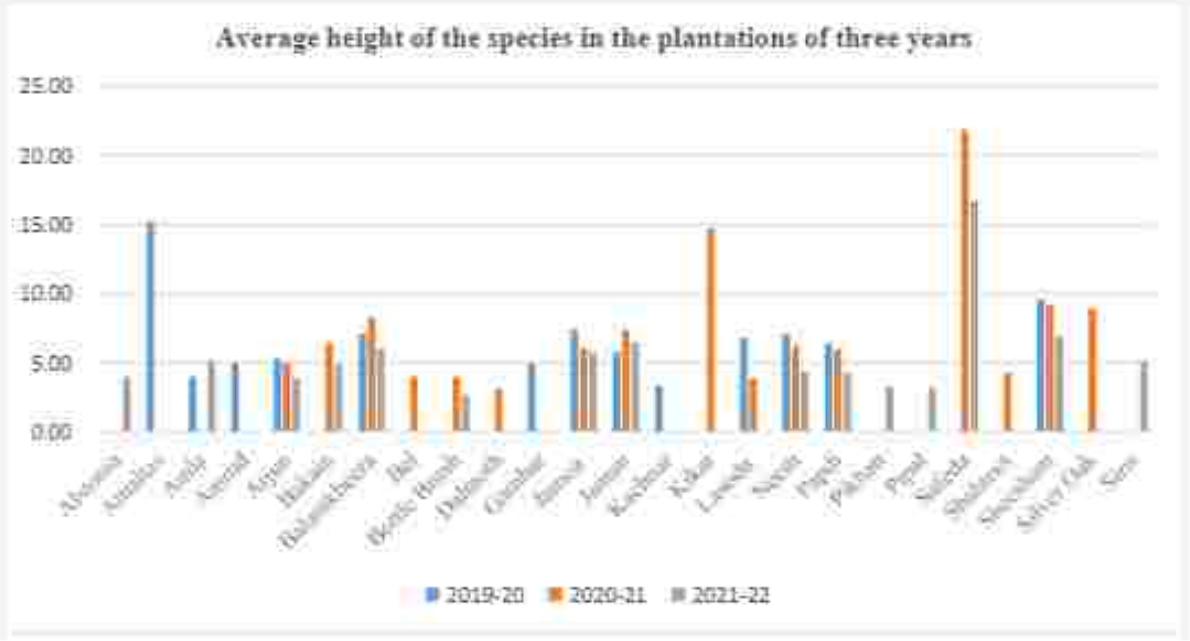

Figure 7.11: Average height of different plant species across three evaluation years

7.2.3. Sustainability

7.2.3.1. Protection

Almost all the plantation sites were carried out without proper protection measures such as fencing, tree guards, cow-proof trenches etc., making these plantation sites prone to the damage inflicted by grazing and browsing animals. Only in two plantations, Nayi Nala Drain (2021-22) and Rana Majra Yamuna Bandh (2021-22) partial perimeter fencing was observed (Figures 7.12 & 7.13). These fencing was proactively done by the forest guard with the help of the local people. Appropriate protection measures should be taken before initiating the plantation activities to avoid

damage to the plantation by grazing animals, trespassers and illegal cutting.

7.2.3.2 Maintenance

The written information/evidence/records for maintenance/replacement of plants such as plantation journals, APOs, plantation maps etc., have not been maintained in any forest range. This is one of the major shortcomings seen across the ranges of Panipat division.

7.2.3.3. Monitoring

Despite of severe grazing pressure, most of the plantations produced good growth and survival and maintained properly. This is the result of the hard work done by forest guards and chowkidaar/watcher. The KII revealed that most of the officers and forest guards are very dedicated and passionate about the afforestation initiative and looks after the sites regularly.

Figure 7.12: Partial perimeter fencing in Nayi Nala Drain plantation site

Figure 7.13: Partial perimeter fencing in Rana Majra Yamuna Sarah plantation site

7.2.4. Scoring of the plantation activities

The plantations carried out under the CAMPA scheme in the year 2019-20, 2020-21, and 2021-22 in the Panipat division scored an average of 157.9, out of 250 (Table 7.19). Overall, the score obtained was satisfactory, considering the severe anthropogenic disturbances in most of the plantation sites.

Table 7.19. Score obtained by the plantations in Panipat division

Year	Component	Range	Name of Plantation Site	100	20	10	10	20	20	20	10	10	10	10	10
				Survival	Growth	Species suitability	Site suitability	Protection	Extent	Journal	Map	Invasive	Species composition	Weeding and hoeing	Watch and ward
2019-20	NPV TP	Panipat	DUK Railway Line	38.1	20.0	10	10	0	20	0	0	10	10	10	10
2019-20	NPV TP	Panipat	Jaondhan Kalan to Karad Road	27.6	20.0	10	10	0	20	0	0	10	10	10	10
2019-20	NPV TP	Panipat	Butana Branch	67.7	20.0	10	10	0	20	0	0	10	10	10	10
2019-20	NPV TP	Samalkha	Mohali to Kurad	77.6	12.0	10	10	0	20	0	0	10	10	10	10
2019-20	NPV TP	Samalkha	Dhindar to Bali road L & R	85.8	20.0	10	10	0	20	0	0	10	10	10	10
2019-20	NPV TP	Samalkha	Chulkana to Patrikalyana Road	81.8	20.0	10	10	0	20	0	0	10	10	10	10
2019-20	CA TP	Samalkha	DUK railway line 65-80 L& R side	56.0	12.0	10	10	0	20	0	0	10	10	10	10
2019-20	CA TP	Panipat	JPR railway line	36.8	20.0	10	10	0	20	0	0	10	10	10	10
2019-20	CA TP	Panipat	Nohra drain RD 0-43	60.8	17.0	10	10	0	20	0	0	10	10	10	10
2019-20	CA TP	Panipat	Jattal drain	11.4	17.0	10	10	0	20	0	0	10	10	10	10
2019-20	CA TP	Samalkha	Drain No. 2 RD 135-150 L&R	56.3	12.0	10	10	0	20	0	0	10	10	10	10
2020-21	CA TP	Samalkha	Drain no. 2 village babail to village khojkipur	73.4	20.0	10	10	0	20	0	0	10	10	10	10
2020-21	CA TP	Smalkha	Yamuna bundh	61.0	17.0	10	10	0	20	0	0	10	10	10	10
2020-21	NPV RIDGE	Panipat	Drain No. 2, Bajida Distry Pul to RD 45 L/Side	72.5	20.0	10	10	0	20	0	0	10	10	10	10

2020-21	NPV RIDGE	Samalkha	Drain No. 2 RD 187 to 204	60.0	20.0	10	10	0	20	0	0	10	10	10	10
2020-21	NPV RIDGE	Panipat	Hansi branch	73.8	20.0	10	10	0	20	0	0	10	10	10	10
2020-21	NPV TP	Panipat	Panipat to Bhandari road	38.2	17.0	10	10	0	20	0	0	10	10	10	10
2020-21	NPV TP	Panipat	Ahulana minor	31.6	17.0	10	10	0	20	0	0	10	10	10	10
2020-21	NPV TP	Panipat	Urlana minor	93.1	17.0	10	10	0	20	0	0	10	10	10	10
2020-21	NPV TP	Samalkha	Samarkha to narayana road	38.0	12.0	10	10	0	20	0	0	10	10	10	10
2020-21	NPV TP	Samalkha	Beholi to Passina road	37.5	17.0	10	10	0	20	0	0	10	10	10	10
2021-22	CA TP	Panipat	Village Assan	76.2	12.0	10	10	0	20	0	0	10	10	10	10
2021-22	CA TP	Panipat	Nayi Nala drain	88.6	17.0	10	10	20	20	0	0	10	10	10	10
2021-22	CA TP	Panipat	Old Badshai canal	65.8	12.0	10	10	0	20	0	0	10	10	10	10
2021-22	CA TP	Panipat	Madlauda minor	75.5	20.0	10	10	0	20	0	0	10	10	10	10
2021-22	CA TP	Panipat	Madlauda minor	56.5	17.0	10	10	0	20	0	0	10	10	10	10
2021-22	CA TP	Panipat	Gohana distributry	44.0	12.0	10	10	0	20	0	0	10	10	10	10
2021-22	CA TP	Samalkha	Panipat drain no. 1	64.3	17.0	10	10	0	20	0	0	10	10	10	10
2021-22	CA TP	Samalkha	Yamuna bundh (Rana Majra)	89.9	17.0	10	10	15	20	0	0	10	10	10	10
2021-22	CA TP	Panipat	Gangesar minor 0-20	33.0	12.0	10	10	0	20	0	0	10	10	10	10
2021-22	NPV RIDGE	Samalkha	Mahawati to Basada road	41.4	20.0	10	10	0	20	0	0	10	10	10	10
2021-22	NPV TP	Panipat	Seenk to chichrana road	52.4	12.0	10	10	0	20	0	0	10	10	10	10
2021-22	NPV TP	Panipat	Waiser to Alipur road	87.5	12.0	10	10	0	20	0	0	10	10	10	10
2021-22	NPV TP	Panipat	Israna distributry	64.7	17.0	10	10	0	20	0	0	10	10	10	10

2021-22	NPV TP	Panipat	Butana branch	79.3	12.0	10	10	0	20	0	0	10	10	10	10
2021-22	NPV TP	Panipat	Israna distributry	87.9	12.0	10	10	0	20	0	0	10	10	10	10
2021-22	CA TP	Samalkha	Narayana a minor RD 12 to 42 L & R	62.0	12.0	10	10	0	20	0	0	10	10	10	10
				60.7	**16.2**	**10.0**	**10.0**	**0.9**	**20.0**	**0.0**	**0.0**	**10.0**	**10.0**	**10.0**	**10.0**

7.3 ROHTAK DIVISION

Table 7.20: CA (Compensatory Afforestation) Plantation sites evaluated in Rohtak Division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
2019-2020	Meham	Lakanmajra	CA TP	Delhi - Jind Rly Line Km 73 - 94 L&R	9.723 ha	9.5 ha	9723	9723	5289	54.4	5.6	19-04-2023
2021-2022	Rohtak	Rohtak (S)	CA TP	NH-71 Km. 357 - 359 L&R & Km. 0 - 3	0.32 ha	0.3 ha	322	322	140	43.5	4.2	15-04-2023

Table 7.21: NPV (Net Present Value) Plantation sites evaluated in Rohtak Division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
						2019-20						
2019-2020	Rohtak	Rohtak North	NPV TP	Rohtak Distributory	14.5 RKM	14.5 RKM	3625	3625	3100	85.5	10.4	12-04-2023
2019-2020	Rohtak	Rohtak (S)	NPV TP	Karontha Ashram to Baland Road	5 RKM	5 RKM	1250	1250	1000	80	8.2	14-04-2023
2019-2020	Meham	Meham	NPV TP	Meham to Bhaini to jafar & Dhanana Road	8 RKM	8 RKM	2000	2000	1430	71.5	5.9	17-04-2023
2019-2020	Meham	Meham	NPV TP	Meham to Badesra Road	7 RKM	7 RKM	1750	1750	1103	63	5.7	17-04-2023
						2020-21						
2020-2021	Rohtak	Sampla	NPV TP	D.J. Railway Line Near Sampla Station	10 RKM	10 RKM	2500	2500	2000	80	9.1	13-04-2023
2020-2021	Rohtak	Rohtak (N)	NPV TP	Drain No. 8	5 RKM	5 RKM	1250	1250	1000	80	6.5	14-04-2023
2020-2021	Meham	Lakhan Majra	NPV TP	BSB Canal L side	10 RKM	10 RKM	2500	2500	1247	49.9	6	18-04-2023

2020-2021	Meham	Meham	NPV TP	Behlba to sisar L&R side	8 RKM	8 RKM	2000	2000	1320	66	5.8	17-04-2023
2020-2021	Meham	Meham	NPV TP	Bharo Bhaini to Badesra Road L&R Side	6 RKM	6 RKM	1500	1500	932	62.1	3.9	17-04-2023
2020-2021	Meham	Meham	NPV TP	Nidana Minor L&R Side	5 RKM	5 RKM	1250	1250	841	67.3	5.8	20-04-2023
						2021-22						
2021-2022	Rohtak	Rohtak North	NPV RIDGE	(Jind Byepass) Gohana Road to Nasirpur Village (L&R)	2 RKM	2 RKM	660	660	500	75.8	4	12-04-2023
2021-2022	Rohtak	Sampla	NPV RIDGE	Ismaila Distributory (L&R)	8.5 RKM	8.5 RKM	2805	2805	2100	74.9	4.4	13-04-2023
2021-2022	Rohtak	Rohtak (S)	NPV TP	Garnawathi Sec. 4 & 5	10 RKM	10 RKM	2500	2500	2150	86	3.8	14-04-2023
2021-2022	Meham	Lakhan Majra	NPV TP	Rohtak - Jind Road	6 RKM	6 RKM	1500	1500	1063	70.9	6.5	18-04-2023
2021-2022	Meham	Lakhan Majra	NPV TP	Gohana to Lakhan Majra road	8 RKM	8 RKM	2000	2000	1012	50.6	5.7	18-04-2023
2021-2022	Meham	L.Majra	NPV TP	Bahu Akabarpur to Samargopalpur	2 RKM	2 RKM	500	500	375	75	4.9	18-04-2023
2021-2022	Meham	Kalanaur	NPV TP	Kalanaur to Nigana Sanghera	6 RKM	6 RKM	1500	1500	1064	70.9	4.9	16-04-2023
2021-2022	Meham	Kalanaur	NPV TP	Kalanaur Minor	8 RKM	8 RKM	2000	2000	1648	82.4	3.8	16-04-2023
2021-2022	Meham	L.Majra	NPV Alkali	Bainsi Forest	10.75 ha	10.5 ha	10750	10750	9000	83.7	3.9	19-04-2023

7.3.1. Relevance

7.3.1.1. Site suitability

- Plantation along the canals performed well

Plantations carried out along a canal or drain have performed very well (Figure 7.14). Due to the presence of the canal, moisture is retained in the soil and the saplings have enough water. Most of these plantations were inaccessible by vehicle, so the grazing or any other anthropogenic pressure is almost absent. Arjun, Jamun, Sheesham etc. which can grow in waterlogged conditions were planted to ensure the survival of the plantation.

Figure 7.14: Along the canal, plantation showed good growth and survival

- Plantations beside the agricultural field have performed well

The plantation sites which are located beside the agricultural fields have particularly performed well (Figure 7.15). This is because farmers apply fertilizers to their crops, which also benefit the planted saplings. The saplings also get steady supply of water from the irrigated agricultural fields.

Figure 7.15: Plantations beside agricultural fields attained good growth

- Plantation in alkaline soil attained good survival but was also damaged due to wildlife browsing

In the sites with alkaline soil, Jungle Jalebi, Neem, Bottle Brush etc were planted. However most of the saplings are found to be destroyed by monkeys or stunted due to wildlife browsing (Figure 7.16). The porcupines also cause severe damage to the roots of the plants. Tree-specific protection measures like bamboo tree guards should be used to ensure the survival of the saplings.

Figure 7.16. Destroyed and stunted saplings due to wildlife browsing (Bainsi Forest, NPV Alkali 2021-22)

- Plantations along the railway line suffered from severe grazing and waterlogging

Plantations carried out along the railway lines were found to be suffered from grazing, fire, waterlogging, and excessive growth of perennial grasses (Figure 7.17). The area is situated beside a dense settlement with livestock populations. According to the forest officials, the local people pose their claim on the plantation land often and create menace. The area also gets waterlogged especially during and after monsoon, which hampers the growth and survival of the planted species. Some parts of the plantations were carried out in an existing vegetation of perennial grasses such as *Saccharum* sp., which is very prone to fire.

Figure 7.17: Plantation along the railway lines. (1) fire caused by the local people (2) saplings died due to excessive waterlogging

- Abundance of invasive species

The presence of invasive species in an afforestation site can cause a great deal of long-term damage to the planted saplings. These species are known to release allelopathic chemicals into the soil and create impenetrable canopy cover which hampers the growth of the native species and regeneration of existing tree species. In the Rohtak division, the presence of invasive species such as *Prosopis juliflora, Argemone mexicana, Parthenium hysterophorus* etc. were observed in almost every afforestation site (Figure 7.18).

Figure 7.18: Abundance of (1) Argemone mexicana and (2) Prosopis juliflora inside the plantation

- Impact of grazing

Grazing is one of the most detrimental factors behind the failure of an afforestation initiative. In Rohtak, some of the sites were severely impacted by grazing. The plantation of Garnawati Sec 4 & 5 (2021-22) were found to be damaged by herds of extremely hostile feral cows (Figure 7.19). Most of the planted species in these plantations were found to be dead or stunted. Proper protection measures like peripheral or tree specific fencing, Cattle Proof Trench (CPT), etc. need to be deployed to protect the saplings from grazing.

Figure 7.19: Stunted growth of the saplings due to severe grazing

7.3.1.2 Species suitability

- Overall species selection in the Rohtak division was found to be satisfactory.
- In most of the plantations, fast-growing fire-resilient native species like Sheesham (*Dalbergia sissoo*), Arjun (*Terminalia arjuna*) etc. were planted.
- In roadside plantations, Balamkheera (*Kigelia pinnata*) was planted, which attained a height of 10-15 feet within 3-4 years of plantation.
- Papdi (*Holoptelea integrifolia*) was found in almost all plantations and attained good growth since cattle do not prefer it for grazing.
- In alkaline soil resilient species like Jungle Jalebi (*Pithecellobium dulce*), Neem (*Azadirachta indica*), Bakain (*Melia azadarach*) were planted.
- In the plantation of Bainsi Forest (NPV Alkali, 2021-22), exotic species like Bottle Brush were planted. It is strongly recommended, that exotic species should be excluded from species mix.

7.3.2. Effectiveness

7.3.2.1. Survival of the plantation

The average survival rate of the plantations in Rohtak division was calculated as 70.16 %, and it varied from as low as 43.48 % (NH-71 Km. 357 - 359 L&R & Km. 0 – 3, 2021-22) to as high as 86.52 % (Rohtak Distributary, 2019-20). Highest survival percentage was observed for the plantations established during 2021-22 followed by years 2019-20 and 2020-21 respectively (Table 7.22).

Table 7.22: Year-wise survival rate and average height of saplings

S.no.	Year	Survival (%)	Height (ft.)
1	2019-2020	71.09	8.2
2	2020-2021	67.55	7.5
3	2021-2022	71.36	4.2

7.3.2.2. Growth of the planted species

Among all the planted species, Dalmoth, Bakain and Bottlebrush attained the most height in the plantations of 2019-20, 2020-21 and 2021-22 (Table 7.23 & Figure 7.20), respectively. Neem, Balamkheera and Siris also attained impressive growth in 3 years.

Table 7.23: Average height of different plant species in three plantation years

Sl.	Planted species		Plantation year		
	Local Name	Botanical Name	2019-20	2020-21	2021-22
1	Arjun	*Terminalia arjuna*	7.4	4.8	4.7
2	Papdi	*Holoptelea integrifolia*	7.2	5.0	4.7
3	Sheesham	*Dalbergia sissoo*	7.1	7.0	5.0
4	Bottle brush	*Callistemon sp.*	8.5	7.3	6.4
5	Neem	*Azadirachta indica*	11.0	8.4	5.0
6	Jamun	*Syzygium cumini*	7.5	4.1	2.3
7	Kachnar	*Bauhinia variegata*	7	-	
8	Pilkhan	*Ficus virens*	7		3
9	Casurina	*Casurina equisetifolia*			3
10	Mango	*Amangifera indica*			6
11	Siris	*Albizia lebback*	7	11	6
12	Bakain	*Melia azadarach*	7	9.5	2.5
13	Dalmoth	*Acacia aunculiformis*	15	8	
14	Jungle Jalebi	*Pithecellobium dulce*	4	7.5	3.5
15	Alianthus	*Alianthus excelsa*	5.5	8	
16	Amaltas	*Cassia fistula*		10	2.75
17	Jakranda	*Jacaranda mimosifolia*		5	
18	Shehtoot	*Moras alba*	6	8	
19	Banyan	*Ficus benghalensis*	12		
20	Peepal	*Ficus religiosa*	12		
21	Gulmohar	*Delonix regia*			4
22	Balamkheera	*Kigelia pinnata*	7.5	10	5.9

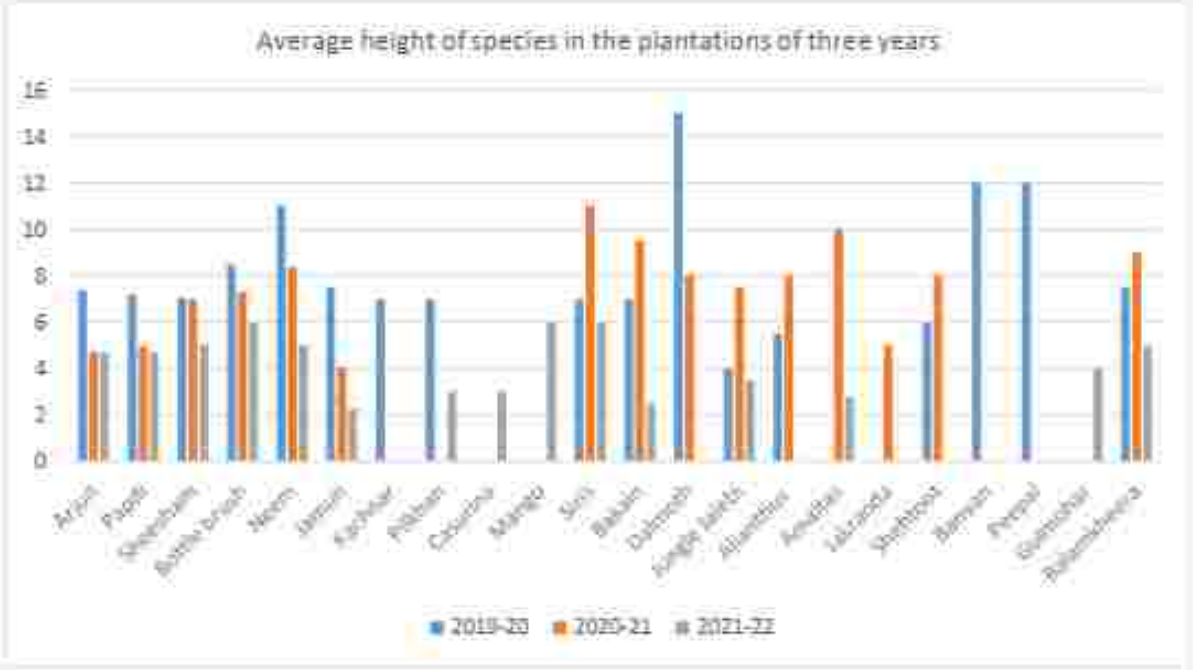

Figure 7.20: Average height of different plant species across three evaluation years

7.3.3. Sustainability

7.3.3.1. Protection measure

All the plantation sites of Rohtak division lack any kind of protective measure to prevent grazing. Only in Bainsi Forest NPV Alkali (2021-22), partial perimeter fencing was found (Figure 7.21). According to the forest officials, no funding was primarily allocated for fencing. If there were some, it takes usually almost 2 years (after plantation) to come through the proper channel. It is strongly recommended, that funding should be allocated for adequate perimeter/tree-specific fencing (Barbed wire/CPT or bamboo tree guard), and should be released on time.

Figure 7.21 Partial perimeter fencing (Barbed wire) in Bainsi Forest plantation site, Meham Range

7.3.3.2 Maintenance

The written information/evidence/records for maintenance/replacement of plants such as plantation journals, APOs, plantation maps, etc., have not been maintained in any forest range. This is one of the major shortcomings seen across the ranges of the Rohtak division.

7.3.3.3 Monitoring

Regular monitoring was observed in all the plantation sites of the Jhajjar division. Chowkidaar/watchers have been appointed in all the forest ranges to take care of plantation sites.

7.3.4. Scoring of the plantation activities

The plantations carried out under the CAMPA scheme in the Rohtak division in the year of 2019-20, 2020-21 and 2021-22 scored an average of 169.2, out of 250 (Table 7.24). Overall, the score obtained was satisfactory, considering the immense grazing pressure and other anthropogenic disturbances observed in most of the plantation sites.

Table 7.24: Score obtained by the plantations in Rohtak division

	Plantation Site	Survival	Growth	Species suitability	Site suitability	Protection	Extent	Journal	Map	Invasive	Species composition	Weeding and hoeing	Watch and ward
1	Rohtak Distributory	85.5	20	10	10	0	20	0	10	10	10	10	10
2	(Jind Byepass) Gohana Road to Nasirpur Village (L&R)	75.7	15	10	10	0	20	0	10	10	10	10	10
3	Ismaila Distributory (L&R)	74.8	15	10	10	0	20	0	10	0	10	10	10
4	D.J. Railway Line Near Sampla Station	80	20	10	10	0	20	0	10	0	10	10	10
5	Drain No. 8	80	17	10	10	0	20	0	10	0	10	10	10
6	Gamawathi Sec. 4 & 5	86	17	10	10	0	20	0	10	5	10	10	10
7	Karonfha Ashram to Baland Road	80	18	10	10	0	20	0	10	0	10	10	10
8	NH-71 Km. 357 - 359 L&R & Km. 0 - 3	43.4	20	10	10	0	20	0	10	0	10	10	10
9	BSB Canal L side	49.9	17	10	10	0	20	0	10	0	10	10	10
10	Rohtak - Jind Road	70.8	17	10	10	0	20	0	10	0	10	10	10
11	Gohana to Lakhan Majra road	59.6	15	10	10	0	20	0	10	0	10	10	10
12	Bahu Akabarpur to Samargopalpur	75	17	10	10	0	20	0	10	0	10	10	10
13	Kalanaur to Nigana Sanghera	70.9	17	10	10	0	20	0	10	0	10	10	10
14	Meham to Bhaini to jatai & Dhanana Road	71.5	17	10	10	0	20	0	10	0	10	10	10
15	Meham to Badesra Road	63	15	10	10	0	20	0	10	0	10	10	10
16	Behlba to sisar L&R side	66	16	10	10	0	20	0	10	0	10	10	10
17	Bharo Bhaini to Badesra Road L&R Side	62.1	18	10	10	0	20	0	10	0	10	10	10

18	Kalanaur Minor	82.4	18	10	10	0	20	0	10	0	10	10	10
19	Nidana Minor L&R Side	67.2	16	10	10	0	20	0	10	0	10	10	10
20	Bainsi Forest	83.7	18	10	10	20	20	0	10	0	10	10	10
21	Delhi - Jind Rly Line Km 73 - 94 L&R	54.4	15	10	10	0	20	0	10	0	10	10	10
		70.1	17.0	10	10	1.0	20	0	10	1.2	10	10	10

7.4 SONIPAT DIVISION

Table 7.25: CA (Compensatory Afforestation) plantation activities evaluated in the Sonipat division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
2019-20	Rai	Bawana	CA TP	Delhi Tail RD 30 to 34 R/Side (Beat Siraspur)	0.73 Ha	4.68RKM	730	730	453	62%	14.8	Apr-23
2020-21	Sonipat	Dubheta	CA TP	CLC RD 128-135 (Beat-Khubru)	0.78 Ha	6 RKM	780	780	496	52%	5.2	
2020-21	Sonipat	Dubheta	CA TP	CLC RD 144-160 (Beat-Khubru)	2.02 Ha	13.7 RKM	2020	2020	1192	59%	5.6	
2020-21	Sonipat	Sonipat	CA TP	CLC RD 190-205 (Beat-Barwasni)	1.93 Ha	10RKM	1930	1930	1496	77%	7.2	
2020-21	Sonipat	Ganaur	CA TP	CLC RD 128-135 (Beat-Ganaur)	1.1 Ha	6 RKM	1100	1100	803	73%	3.1	

Table 7.26: NPV (Net Present Value) plantation activities evaluated in the Sonipat division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
						2019-20						Apr-23
2019-20	Sonipat	Dubheta	NPV TP	Delhi Parallel (Khubru)	3 RKM	4 RKM	750	750	563	75%	5.2	

2019-20	Gohana	Gohana	NPV TP	Khanpur Shamri Road (Khanpur)	6.48 RKM	10.5RKM	1620	1620	1004	62%	10.5
2019-20	Gohana	Moi	NPV TP	Lath Majra Road (Lath)	3.6 RKM	6RKM	900	900	540	60%	10.2
2019-20	Rai	Kharkhoda	NPV TP	Thana Khurd to Jattola Road (Jharoth)	3.36 RKM	6RKM	840	840	470	56%	8.2
2019-20	Rai	Bawana	NPV TP	Delhi Tail 50-65 (Shastri Nagar)	2.4 RKM	6RKM	600	600	240	40%	5.9
						2020-21					
2020-21	Rai	Bahalgarh	NPV TP	1-L Minor (Khewra)	2.88 RKM	8RKM	720	720	259	36%	3.6
2020-21	Rai	Kharkhoda	NPV TP	Jyonti Minor (Kharkhoda)	2.52 RKM	4RKM	630	630	397	63%	7.2
2020-21	Gohana	Kathura	NPV TP	Gohana Julana Road 6 RKM (Beat - Ahulana)	4 RKM	6RKM	1000	1000	670	67%	6.9
2020-21	Gohana	Kathura	NPV TP	Gohana Julana Road 5 RKM (Beat-Rindhana)	3.32 RKM	5RKM	830	830	548	66%	5.7

2020-21	Gohana	Gohana	NPV TP	Kasndi Khanpur Bajana Road (Khanpur)	4.08 RKM	5RKM	1020	1020	826	81%	5.5
2020-21	Gohana	Kathura	NPV TP	Baroda Kailpa Road (Ahulana)	5 RKM	5RKM	1250	1250	1025	82%	8
2020-21	Gohana	Kathura	NPV TP	Kathura Chhicrana Road (Kathura)	2.32 RKM	3RKM	580	580	447	77%	8
2020-21	Gohana	Moi	NPV TP	Rivara Minor (Moi)	1.68 RKM	4RKM	420	420	176	42%	3.6
2020-21	Rai	Kharkhoda	NPV Ridge	Jhinjholi Drain (Nahra)	6 RKM	6RKM	1820	1820	1110	61%	24.6
2020-21	Sonipat	Dubheta	NPV Ridge	Sheikpura Minor RD 0-6 L&R (Khubru)	6 RKM	6 RKM	1470	1470	720	49%	13.8
2020-21	Gohana	Bichpari	NPV Ridge	Butana Branch (Ishapur Kheri)	8 RKM	8RKM	2670	2670	1762	66%	14.8
						2021-22					
2021-22	Gohana	Bichpari	NPV TP	Gohana Safindon Road KM 3-15 (Bicpari)	6.008 RKM	9 RKM	1502	1502	991	66%	4.6

2021-22	Rai	Kharkhoda	NPV TP	Khanda Kheri Dahiya Road (Kharkhoda)	3.28 RKM	5RKM	820	820	533	65%	4.3
2021-22	Rai	Kharkhoda	NPV TP	NH-334 UP Jhajjar Highway (Garhi Bindhroli)	6.48 RKM	12RKM	1620	1620	875	54%	5.1
2021-22	Rai	Kharkhoda	NPV TP	Kawali Mandora Road (Garhi Bindhroli)	3.68 RKM	5RKM	920	920	681	74%	5.1
2021-22	Sonipat	Sonipat	NPV TP	Mahra to Chitana Road (Barwasni)	3.2 RKM	4 RKM	800	800	640	80%	6.9
2021-22	Sonipat	Dubbeta	NPV TP	Purkhas to Dabaur Road (Purkhas)	4.772 RKM	5 RKM	1193	1193	942	79%	4.9
2021-22	Sonipat	Dubbeta	NPV TP	Panchi Mahra Sitawali Road (Purkhas)	4.292 RKM	6 RKM	1073	1073	762	71%	5.6
2021-22	Sonipat	Sonipat	NPV TP	Gumar to Garhi Jhajjara Road (Ganaur)	3.6 RKM	5 RKM	900	900	648	72%	4.8

2021-22	Gohana	Bichpari	NPV TP	Butana Branch Radd Side RD 60-100 (Beat-Ishapur Kheri)	4.2 RKM	8RKM	1050	1050	546	52%	4.9
2021-22	Gohana	Moi	NPV TP	BSB RD 83-102 (Beat-Moi)	3.84 RKM	9RKM	960	960	413	43%	4.1
2021-22	Rai	Bawana	NPV TP	Bawana Scap (Beat-Bawana)	2.88 RKM	8RKM	720	720	259	36%	3.3
2021-22	Rai	Bawana	NPV Ridge	Sultanpur (Beat Karala)	14 RKM	14RKM	2730	2730	1065	39%	3.3
2021-22	Sonipat	Dubheta	NPV Ridge	CLC RD 160-178 L/Side (Beat-Purkhas / Kallana)	25 RKM	25 RKM	12500	12500	8000	64%	4.6

7.4.1. Relevance

7.4.1.1. Site suitability

Most of the plantation sites are present beside the agricultural fields and on the ridges. All the species have performed well in these plantation sites due to the presence of sufficient soil moisture (Figure 7.22). Sheesham (*Dalbergia sissoo*), Papdi (*Holoptelea integrifolia*) and Balmkheera (*Kigelia pinata*) were found as the most common species planted beside the agricultural fields. The Eucalyptus was seen as the most common planted species in the ridge plantation sites. Although all the plant species performed well Papdi was seen as least affected by grazing.

Figure 7.22: Planted species showing excellent growth

- Sites adjacent to the agricultural field have performed well

The plantation sites which are located beside the agricultural fields have particularly performed well (Figure 7.23). This is because farmers apply fertilizers to their crops, which also benefit the planted saplings. The saplings also get a steady supply of water from the irrigated agricultural fields.

Figure 7.23: Species (Kigelia pinata) planted beside agricultural fields showed good growth

❖ NPV Ridge sites have performed well

In the NPV Ridge sites of this division, all the planted species have performed very well due to the retained soil moisture inside the furrows (Figure 7.24). Also, the site was regularly monitored and ridges were found to be maintained properly.

Figure 7.24: Plantation sites on ridges

In NPV Ridge sites, Safeda (*Eucalyptus sp.*) was planted extensively. Although it shows exceptional growth, native fast-growing tree species are suggested to be included in the species mix, instead of *Eucalyptus*, which is a severe water-intensive exotic plant.

Although most of the sampled sites produced satisfactory survival, some of them were found to be impacted by heavy grazing, abundance of invasive species, Fire, damage by local people, Construction along the roads and Monkeys.

❖ Impact of cattle grazing

Moderate to severe grazing was observed across the plantation sites in the Sonipat division. The grazing has severely affected the growth and survival of saplings in some plantation sites. Most of the grazing is done by cattle and goats which belong to local people. Therefore, appropriate protection measures should be taken to prevent the damage caused to the plantations by grazing animals.

❖ Effect of Fire

Farmers in the Panipat division set fire to the cultivated fields to clear stubble, weeds, and waste before sowing new crops. Due to the absence of a fire line, fire has affected saplings in a few plantation sites. The forest department should take appropriate steps such as drawing fire lines and engaging people through awareness programs, emphasizing the importance of plants to their survival.

❖ Anthropogenic disturbances

The plantations suffer damage from local people through unauthorized and illegal collection of saplings as fuelwood. Furthermore, the farmers damage the saplings in the plantation sites which are close to their crop fields (Figure 7.25), due to the fear that these would shade their crop fields and reduce crop production. Proper management measures are needed to prevent such anthropogenic damage to the plantations.

Figure 7.25: Plants damaged by local people

- Damage caused by Monkeys

The arboreal locomotion of monkeys has inflicted damage to saplings in some plantation sites. Chemical repellents or loud heavy noise may be used to keep monkeys away from the plantation and avoid damage to the plants.

- Impact of road construction

The survival rate of roadside plantations is being affected by construction activities (Figure 7.26). Proper management strategies including regular monitoring should be employed to ensure the protection of plantations along the roads.

Figure 7.26: Plantation was destroyed due to construction

7.4.1.2 Species suitability

Papdi (*Holoptelia intigrifolia*), Sheesham (*Dalbergia sissoo*), Arjun (*Terminalia arjuna*), and Jungle Jalebi (*Pithecellobium dulce*) are the predominant plant species planted in Jhajjar division (Table 7.27). These species exhibit excellent adaptability to local conditions and demonstrate a higher survival rate across various sites, including roadsides, along the canal/s, and near agricultural fields.

Table 7.27 Species planted in the plantations in the Sonipat division

Sl. No.	Planted Species	
	Local Name	**Botanical Name**
1	Aam	*Mangifera indica*
2	Alstonia	*Alstonia scholaris*
3	Amaltas	*Cassia fistula*
4	Amrud	*Psidium guajava*
5	Arjun	*Terminalia arjuna*
6	Bakain	*Melia azadirachta*
7	Balamkheera	*Kigelia pinnata*
8	Bauhinia	*Bahaunia sp*
9	Bottle Brush	*Melaleuca viminalis*
10	Dalmoth	*Acacia auriculiformis*
11	Gular	*Ficus racemosa*
12	Jamoa	*Eugenia jambolana*
13	Jamun	*Syzygium cumini*
14	Jungle Jalebi	*Pithecellobium dulce*
15	Kat Sagon	*Heterophragma adenophyllum*
16	Kikar	*Acacia nilotica*
17	Neem	*Azadirachta indica*
18	Papdi	*Holoptelea integrifolia*
19	Pilkhan	*Ficus virens*
20	Safeda	*Eucalyptus sp.*

21	Sagon	*Tectona grandis*
22	Senna	*Senna siamea*
23	Sheesham	*Dalbergia sissoo*
24	Silver Oak	*Grevillea robusta*
25	Siris	*Albizia procera*
26	Toon	*Toona ciliata*

7.4.2. Effectiveness

7.4.2.1. Survival of the plantation

The average survival rate of Plantation was recorded as 62% and it varied from as low as 36% (1-L Minor, Khewra and Bawana Scap, Beat-Bawana) to as high as 82% (Baroda Kallpa Road, Ahulana). Among the three plantation years highest survival percentage (62%) was found in plantations established during the year (2020-2021), followed by the plantation of years 2021-22 and 2019-20 respectively (Table 7.28).

Table 7.28: Year-wise survival rate and average height of saplings

S.no.	Year	Survival (%)	Height (ft.)
01	2019-2020	59	9.1
02	2020-2021	62	4.6
03	2021-2022	61	4.7

7.4.2.2. Growth of the planted species

Kat-Sagon (*Fernandoa adenophylla*), Safeda (*Eucalyptus sp.*), and Sagon (*Tectona grandis*) attained the highest growth in 2019-20, 2020-21 and 2021-22 plantations respectively (Table 7.29, Figure 7.27).

Table 7.29: Average height (ft.) of the species planted in three plantation years

	Planted Species		Plantation Year		
SNO	Local Name	Botanical Name	2019-20	2020-21	2021-22
1	Aam	*Mangifera indica*	5.4	-	-
2	Alstonia	*Alstonia scholaris*	-	-	3.8
3	Amaltas	*Cassia fistula*	7.3	7.0	-
4	Amrud	*Psidium guajava*	5.2	8.3	3.5
5	Arjun	*Terminalia arjuna*	7.8	6.0	4.3
6	Bakain	*Melia azadirachta*	-	5.2	-

7	Balamkheera	*Kigelia pinnata*	3.8	4.3	5.7
8	Bauhinia	*Bahaunia sp*	-	8.7	4.1
9	Bottle Brush	*Melaleuca viminalis*	-	5.7	5.8
10	Dalmoth	*Acacia auriculiformis*	3.4	6.4	4.3
11	Gular	*Ficus racemosa*	-	4.1	-
12	Jamoa	*Eugenia jambolana*	-	4.8	-
13	Jamun	*Syzygium cumini*	6.2	4.0	3.7
14	Jungle Jalebi	*Pithecellobium dulce*	3.6	4.6	4.4
15	Kat Sagon	*Heterophragma adenophyllum*	15.3	-	-
16	Kikar	*Acacia nilotica*	-	13.9	3.6
17	Neem	*Azadirachta indica*	6.3	7.5	4.8
18	Papdi	*Holoptelea integrifolia*	7.3	5.7	4.4
19	Pilkhan	*Ficus virens*	-	3.2	-
20	Safeda	*Eucalyptus sp*	-	22.7	2.5
21	Sagon	*Tectona grandis*	-	-	8.1
22	Senna	*Senna siamea*	9.6	-	-
23	Sheesham	*Dalbergia sissoo*	7.5	6.0	4.9
24	Silver Oak	*Grevillea robusta*	-	-	4.8
25	Siris	*Albizia procera*	-	4.9	5.0
26	Toon	*Toona ciliata*	-	-	2.4

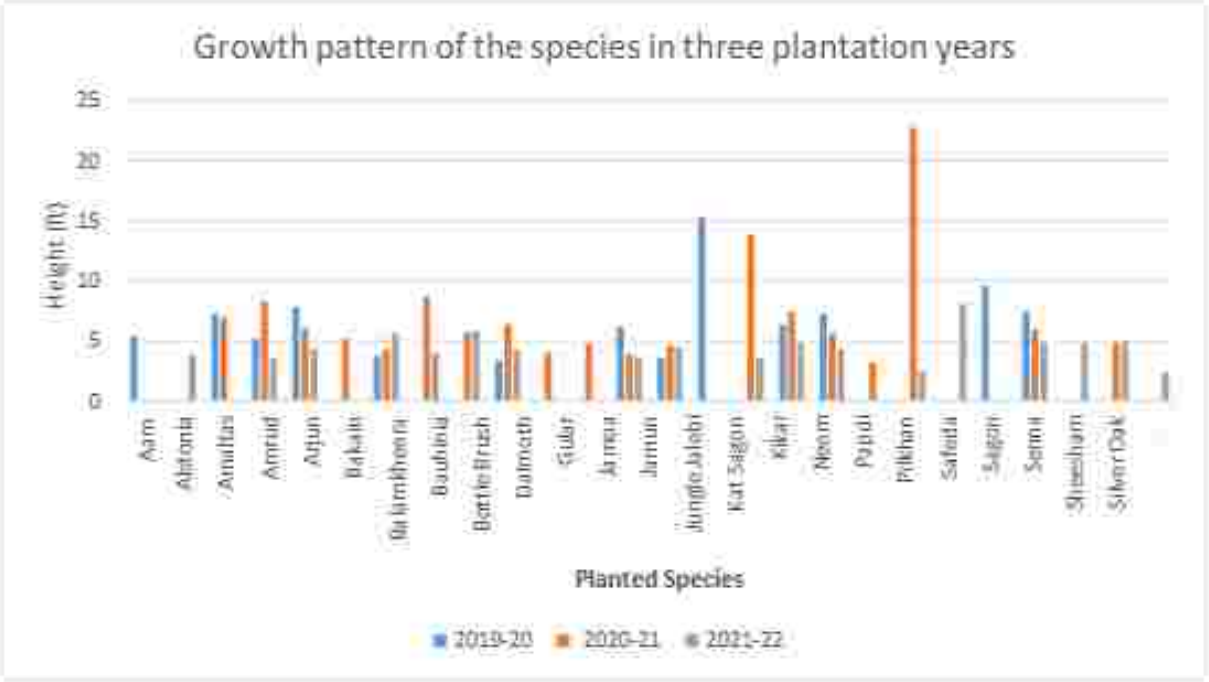

Figure 7.27. Growth patterns of different plant species

7.4.3. Sustainability

7.4.3.1. Protection

All the plantation sites of the Sonipat division lack effective protection measures. Plantation sites are without fencing and are thus prone to damage inflicted by grazing animals and local people. Appropriate protection measures should be taken before conducting plantation activities to avoid damage to the plantation by grazing animals, trespassers, and unauthorized harvesting.

7.4.3.2. Maintenance

The written information/evidence/records for maintenance/replacement of plants providing details of species and number of plants planted was not available in any forest range of Sonipat division.

7.4.3.3. Monitoring

Proper monitoring was not observed in any of the plantation sites in the Sonipat division. The watcher or Chowkidaar has not been appointed in any forest range to take care of plantation sites. The forest guard has to monitor all the sites in a beat which makes it troublesome for him to effectively monitor these sites.

7.4.4. Scoring of the plantation works:

The plantations carried out under the CAMPA scheme in the year 2019-20, 2020-21 and 2021-22 scored an average of 123.5, out of 250 (Table 7.30). Overall, the score obtained was satisfactory, considering the water-scarce terrain, grazing pressure, and severe anthropogenic disturbances observed in most of the plantation sites.

Table 7.30: Score obtained by the plantations in the Sonipat division

Year	Range	Component	Name of the site	Survival	Growth	Species suitability	Site suitability	Protection	Extent	Journal	Map	Invasive	Species composition	Weeding and hoeing	Watch and ward
2019-20	Sonipat	NPV TP	Delhi Parallel (Khubru)	75	15	10	10	0	20	0	0	10	10	10	10
2019-20	Gohana	NPV TP	Khanpur Sharnri Road (Khanpur)	62	20	10	10	0	20	0	0	10	10	10	10
2019-20	Gohana	NPV TP	Lath Majra Road (Lath)	69	20	10	10	0	20	0	0	10	10	10	10
2019-20	Rai	NPV TP	Thana Khurd to Jattola Road (Jharoth)	56	19	10	10	0	20	0	0	10	10	10	10
2019-20	Rai	NPV TP	Delhi Tail 50-65 (Shastri Nagar)	40	15	10	10	0	20	0	0	10	10	10	10
2019-20	Rai	CA TP	Delhi Tail RD 30 to 34 R/Side	62	20	10	10	0	20	0	0	10	10	10	10

			(Beat Siraspur)												
2020-21	Rai	NPV TP	1-L Minor (Khewra)	36	15	10	10	0	20	0	0	10	10	10	10
2020-21	Rai	NPV TP	Jyonti Minor (Kharkhoda)	63	18	10	10	0	20	0	0	10	10	10	10
2020-21	Gohana	NPV TP	Gohana Julana Road 6 RKM (Beat - Ahuiana)	67	17	10	10	0	20	0	0	10	10	10	10
2020-21	Gohana	NPV TP	Gohana Julana Road 5 RKM (Beat-Rindhana)	66	16	10	10	0	20	0	0	10	10	10	10
2020-21	Gohana	NPV TP	Kasndi Khanpur Bajana Road (Khanpur)	81	15	10	10	0	20	0	0	10	10	10	10
2020-21	Gohana	NPV TP	Baroda Kailpa Road (Ahulana)	82	17	10	10	0	20	0	0	10	10	10	10
2020-21	Gohana	NPV TP	Kathura Chhicrana Road	77	18	10	10	0	20	0	0	10	10	10	10

			(Kathura)													
2020-21	Gohana	NPV TP	Riwara Minor (Moi)	42	15	10	10	0	20	0	0	10	10	10	10
2020-21	Rai	NPV Ridge	Jhinjholi Drain (Nahra)	61	20	10	10	0	20	0	0	10	10	10	10
2020-21	Sonipat	NPV Ridge	Sheikpura Minor RD 0-6 L&R (Khubru)	49	20	10	10	0	20	0	0	10	10	10	10
2020-21	Gohana	NPV Ridge	Butana Branch (Ishapur Kheri)	66	20	10	10	0	20	0	0	10	10	10	10
2020-21	Sonipat	CA TP	CLC RD 128-135 (Beat-Khubru)	52	16	10	10	0	20	0	0	10	10	10	10
2020-21	Sonipat	CA TP	CLC RD 144-160 (Beat-Khubru)	59	18	10	10	0	20	0	0	10	10	10	10
2020-21	Sonipat	CA TP	CLC RD 190-205 (Beat-Barwasni)	77	19	10	10	0	20	0	0	10	10	10	10
2020-21	Sonipat	CA TP	CLC RD 128-135 (Beat-Gannaur)	73	15	10	10	0	20	0	0	10	10	10	10
2021-22	Gohana	NPV TP	Gohana Safindon Road KM 3-	66	16	10	10	0	20	0	0	10	10	10	10

			15 (Bicpari)												
2021-22	Rai	NPV TP	Khanda Kheri Dahiya Road (Kharkhoda)	65	18	10	10	0	20	0	0	10	10	10	10
2021-22	Rai	NPV TP	NH-334 UP Jhajjar Highway (Garhi Bindhroli)	54	15	10	10	0	20	0	0	10	10	10	10
2021-22	Rai	NPV TP	Kawali Mandora Road (Garhi Bindhroli)	74	17	10	10	0	20	0	0	10	10	10	10
2021-22	Sonipat	NPV TP	Mahra to Chitana Road (Barwasni)	80	18	10	10	0	20	0	0	10	10	10	10
2021-22	Sonipat	NPV TP	Purkhas to Dabaur Road (Purkhas)	79	16	10	10	0	20	0	0	10	10	10	10
2021-22	Sonipat	NPV TP	Panchi Mahra Sitawali Road (Purkhas)	71	16	10	10	0	20	0	0	10	10	10	10

2021-22	Sonipat	NPV TP	Gumar to Garhi Jhajjara Road (Ganaur)	72	16	10	10	0	20	0	0	10	10	10	10
2021-22	Gohana	NPV TP	Butana Branch Radd Side RD 60-100 (Beat-Ishapur Kheri)	52	16	10	10	0	20	0	0	10	10	10	10
2021-22	Gohana	NPV TP	BSB RD 83-102 (Beat-Moi)	43	16	10	10	0	20	0	0	10	10	10	10
2021-22	Rai	NPV TP	Bawana Scap (Beat-Bawana)	36	15	10	10	0	20	0	0	10	10	10	10
2021-22	Rai	NPV Ridge	Sultanpur (Beat Karala)	39	15	10	10	0	20	0	0	10	10	10	10
2021-22	Sonipat	NPV Ridge	CLC RD 160-178 L/Side (Beat-Purkhas / Kallana)	64	16	10	10	0	20	0	0	10	10	10	10
				62	17	10	10	0	20	0	0	10	10	10	10

7.5 KARNAL DIVISION

Table 7.31. CA (Compensatory Afforestation) plantation sites evaluated in Kamal Division

Year	Range	Block	Component	Name of the Site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survival (%)	Average Height (Ft.)	Date of visit
						2019-20						April-May, 2023
2019-2020	Kamal	Kunjpura	CA TP	RF Shekpura	6.7 Ha	6.15 Ha	6700	6700	5900	88.059	4.333	
2019-2020	Assandh	Assandh	CA TP	RF Bassi Coup no. Tehsil Assandh	6.17 Ha	6 Ha	6170	6170	5183	84.003	8.5	
2019-2020	Assandh	Assandh	CA TP	RF Bassi (5.27)	5.27 Ha	5.27 Ha	5270	5270	4216	80	10	
2019-2020	Kamal	Munak	CA TP	Drain no.2 Nanipal dera to Dadlana bridge	6 Ha	6 Ha	6000	6000	4020	67	5	
						2020-21						
2020-2021	Assandh	Assandh	CA TP	RF Bassi Coup no.5 & 6	12.38 Ha	12.38 Ha	12380	12380	10523	85	6.333	
2020-2021	Assandh	Jundla	CA TP	Gagsina Minor	4 Ha	4 Ha	4000	4000	2884	72.1	3.67	
2020-2021	Assandh	Jundla	CA TP	Indri drain Kamal	8.5 Ha	8.5 Ha	8500	8500	3879	45.635	4.333	
2020-2021	Indri	Indri	CA TP	WJC main lower	8.575 RKM	8.575 RKM	8575	8575	2372	27.661	7.214	
2020-2021	Assandh	Jundla	CA TP	G Drain- Assandh to SVL road L&R	3 Ha	3 Ha	3000	3000	750	25	3.35	
						2021-22						
2021-2022	Assandh	Assandh	CA TP	BM Canal	7.13 Ha	7.13 Ha	7130	7130	6702	93.997	4.142	
2021-2022	Assandh	Jundla	CA TP	Kamal- Assandh road 18-36 L&R	5 Ha	5 Ha	3100	3100	2680	86.451	4.1	
2021-2022	Kamal	Kunjpura	CA TP	RF Shekpura & Indri Escape	2 Ha	2 Ha	2000	2000	1640	82	9.5	
2021-2022	Kamal	Kunjpura	CA TP	Indri escape	8.275 RKM	8.275 RKM	8275	8275	6537	78.996	8.166	
2021-2022	Kamal	Kunjpura	CA TP	Kheri minor	3.05 Ha	3.05 Ha	3050	3050	2372	77.77	5.5	
2021-2022	Indri	Garhi binbal	CA TP	Newal chocyama road	2 Ha	2 Ha	2000	2000	1510	75.5	8	
2021-2022	Kamal	Kunjpura	CA TP	Old WJC road 22-29	4.566 Ha	4.566 Ha	4566	4566	3290	72.054	5.666	
2021-2022	Indri	Garhi binbal	CA TP	Jamuna Bandh	1 Ha	1 Ha	1000	1000	456	45.6	7	
2021-2022	Indri	Nilokheri	CA TP	Sanchili minor	1.5 Ha	1.5 Ha	1500	1500	607	40.466	6.74	

Table 7.32: NPV (Net Present Value) plantation sites evaluated in Ambala Division

Year	Range	Block	Component	Name of the site	Area of Plantation (As per APO)	Actual area using GPS	Physical Target (No. of plants)	No. of Plants planted	No. of Plants survived	Survive l (%)	Average Height (Ft.)	Date of visit
						2019-20						April-May, 2023
2019-2020	Kamal	Munak	NPV TP	Old Badshahi Canal RD Kutana - Bandarl	55 RKM	35 RKM	8000	8000	5520	69	7.833	
2019-2020	Assandh	Nisang	NPV TP	Assandh to Sirsal road	15 RKM	15 RKM	3750	3750	2145	57.2	7.5	
						2020-21						
2020-2021	Indri	Nilokheri	NPV TP	Nardak distributary L&R	20 RKM	20 RKM	5000	5000	2000	40	5	
2020-2021	Assandh	Assandh	NPV Ridge	RF Basai	12 RKM	12 RKM	6000	6000	5520	92	15.333	
2020-2021	Indri	Niguda	NPV TP	Shambhuli to Ramana road L&R	8 RKM	8 RKM	2000	2000	1803	81.65	7.333	
2020-2021	Assandh	Jundla	NPV Ridge	Bundla Channel	18 RKM	18 RKM	9000	9000	6926	76.955	9.75	
2020-2021	Indri	Nilokheri	NPV Ridge	Sansu branch raod	10 RKM	10 RKM	5000	5000	3400	68	23	
2020-2021	Assandh	Assandh	NPV TP	Assandh to Salwan road	12 RKM	12 RKM	3000	3000	1837	61.233	6.5	
2020-2021	Kamal	Munak	NPV TP	Kishorni Assandh road 18-24km	10 RKM	10 RKM	2500	2500	1329	53.12	8.333	
2020-2021	Assandh	Nisang	NPV TP	Amupur - Dhigrana	10 RKM	10 RKM	2500	2500	1239	49.56	9.606	
2020-2021	Indri	Indri	NPV TP	Indri scape L&R	50 RKM	50 RKM	12500	12500	5725	45.78	6	
						2021-22						
2021-2022	Indri	Nilokheri	NPV TP	Pukhiana branch 0 sonkia rest house	8 RKM	8 RKM	2000	2000	1130	56	4	
2021-2022	Kamal	Kunjpura	NPV TP	indri scape malmgnat to sangatia pul	11 RKM	11 RKM	2750	2750	2530	92	4	
2021-2022	Assandh	Nisang	NPV TP	Kamal -Kaithal road 8-16	12 RKM	12 RKM	3000	3000	2585	86.166	5.5	
2021-2022	Assandh	Assandh	NPV Ridge	Chaiong Drain	31 RKM	31 RKM	15500	15500	12555	81	4.97	
2021-2022	Assandh	Nisang	NPV TP	Kamal -Kaithal road 24-32km	12 RKM	12 RKM	3000	3000	2364	78.466	6.555	
2021-2022	Assandh	Assandh	NPV Ridge	RF Khandakhein	20 RKM	20 RKM	10000	10000	7500	75	7	
2021-2022	Indri	Indri	NPV TP	Indri scape Mohadgarh to Faglpur	16 RKM	16 RKM	4000	4000	3000	75	4	
2021-2022	Indri	Nilokheri	NPV TP	Indri drain7-12	10 RKM	10 RKM	2500	2500	1520	60.8	3.833	
2021-2022	Indri	Budhera	NPV TP	Salarpur road	10 RKM	10 RKM	2500	2500	744	29.76	8.66	
2021-2022	Indri	Budhera	NPV TP	Narwana Branch	10 RKM	10 RKM	2500	2500	126	5.04	3	

7.5.1. Relevance

7.5.1.1 Site suitability

The success of a plantation is influenced by many different factors. One of the major factors is the selection of suitable sites for plantations. Plantation sites having better soil quality, moisture content, and management have better survival percentages.

- Sites adjacent to agricultural fields performed well

Sites that are adjacent to agricultural fields (Figure 7.28) benefit from the periodic application of fertilizers and irrigation from the fields. The presence of canals and drains also had a positive impact on the plantation due to consistent moisture presence. The construction of NPV ridges helps in preserving moisture and helps in the demarcation of the sites.

Figure 7.28: Plantations near agricultural land showing excellent growth

- Damage due to agricultural burning

Incidences of fire relating to stubble burning in the plantations adjoining agricultural fields is a major factor that impacts the survival of the saplings (Figure 7.29). The fire in the agricultural fields spread to the plantations destroying a good percentage of the plantation. Proper measures should be enforced to prevent the spreading of fire into the plantations. The local communities also cut down the saplings as a source of firewood.

Figure 7.29: Damage to plantations due to fire caused by stubble burning in the near by agricultural fields

- Impact of Cattle grazing

Grazing on the plantation sites has a negative impact on the survivability of the plantations (Figure 7.30). The occurrence of grazing can impact the growth and survival rate of the plantations. Grazing was observed in the majority of the plantation sites mostly by domesticated cattle, feral cows and Nilgai. No protective measures were taken up in most of the sites.

Figure 7.30: Severe grazing caused serious damage to the planted saplings

- Abundance of invasive species

The presence of invasive species has a detrimental impact on the survivability of plantations in the long run. The majority of the sampled sites had the presence of one or more invasive species. *Prosopis juliflora*, *Parthenium hysterophorum*, and *Ageratum conzoides* are the major invasive species observed in the plantation sites (Figure 7.31). *Lantana camara* was also observed in some of the sampled sites. Proper management and weed control measure should be implemented to ensure the survival of plantation sites.

Figure 7.31: Abundance of Parthenium hysterophorus in plantation sites

7.5.1.2. Species suitability

- Overall, 24 different planted species were found in the plantation sites of Karnal division (Table 7.33).
- Sheesham, Papadi and Arjun are the most commonly planted species. Safeda was found to be the most planted species in NPV-ridge plantations.

- Papdi and neem are found to be the most impacted by extreme frost. The samplings were dying back in the affected areas (Figure 7.32). Tree-specific protection measures should be used or frost-resistant species such as *Diospyros* sp. or *Lagerstroemia* sp. can be considered for plantation.

Figure 7.32: Damaged Papdi saplings impacted by frost

- Safeda was planted extensively in the NPV Ridge plantations. Safeda is water-intensive and reduces available water for other species by effectively out-competing them. In arid areas, it consequently suppresses different plant life, coupled with high water demand, reduces soil moisture, prevents groundwater recharge, and can reduce local water tables. Exotic species like this should be replaced with native plants in the plantation species mix.

Table 7.33: List of the planted species found in the plantations of Karnal Division

Sr. No.	Local Name	Botanical Name
1	Sheesham	*Dalbergia sisoo*
2	Balamkheera	*Kigelia pinnata*
3	Neem	*Azadirachta indica*
4	Gumhar	*Gmelina arborea*
5	Kikar	*Acacia nilotica*
6	Safed	*Eucalyptus sp.*
7	Arjun	*Terminalia arjuna*
8	Jamun	*Syzygium cumini*
9	Siris	*Albizia lebback*
10	Pilkhan	*Ficus virens*
11	Kachnar	*Bauhinia variegata*
12	Jakranda	*Jacaranda mimosifolia*
13	Peepal	*Ficus religiosa*
14	Bakain	*Melia azedarach*
15	Kadam	*Neolamarckia kadamba*

	16	Bottle bush	*Callistemon lanceolata*
	17	Baheda	*Terminalia bellirica*
	18	Lasoda	*Cordia myxa*
	19	Jungle jalebi	*Pithecellobium dulce*
	20	Amla	*Phyllanthus emblica*
	21	Amrud	*Psidium guajava*
	22	Aam	*Mangifera indica*
	23	Papdi	*Holoptelea integrifolia*

7.5.2. Effectiveness

7.5.2.1. Plant Survival

The average survival rate of the plantation activity for the Karnal division is 65.69 % during the three plantation years (Table 7.34). The highest survival percentage was observed for plantation actives carried out in 2019-2020 (74.21 per cent) and the lowest survival was observed for the plantation actives carried out in the year 2020 -2021 (58.83 per cent). The highest survival was observed in the BM canal (93.99 per cent). The major factors that impacted the survivability of samplings were incidences of fire, grazing and the presence of invasive species.

Table 7.34 Year-wise survival rate and growth of the plantation sites

	Year	Survival (%)	Height (ft.)
1	2019-2020	74.21	7.19
2	2020-2021	58.83	7.85
3	2021-2022	68.08	5.59

7.5.2.2. Growth of the planted species

The majority of the sites showed a satisfactory level of growth. Eucalyptus showed the highest level of growth rate compared to other species (Table 7.35 & Figure 7.33). The average height of the plantation was 7.19 feet in 2019-2020, 7.85 feet in 2020-2021 and 5.59 feet in 2021-2022. Stunted growth was observed in a few plantations due to water scarcity.

Table 7.35. The average height of different plant species across three plantation years

	Planted species		Year of the plantation		
	Local Name	Botanical Name	2019-2020	2020-2021	2021-2022
1	Papdi	*Holoptelea integrifolia*	6.63	5.79	6.33
2	Sheesham	*Dalbergia sissoo*	9.33	7.21	5.83
3	Balamkheera	*Kigelia pinnata*	4.25	6.14	3.86
4	Neem	*Azadirachta indica*	8.67	5.33	3.67
5	Gumhar	*Gmelina arborea*	5.00	6.00	7.50
6	Kikar	*Acacia nilotica*		13.00	
7	Eucalyptus	*Eucalyptus sp.*		19.67	12.00
8	Arjun	*Terminalia arjuna*	4.00	6.58	5.56
9	Jamun	*Syzygium cumini*		4.00	4.13
10	Siris	*Albizia lebbeck*	7.00	9.00	10.00
11	Pilkhan	*Ficus virens*		4.00	6.00
12	Kachanar	*Bauhinia variegata*		10.00	5.50

13	Jakranda	*Jacaranda mimosifolia*		2.00	
14	Peepal	*Ficus religiosa*	7.00	3.75	4.50
15	Bakain	*Melia azedarach*		2.75	4.50
16	Kadam	*Neolamarckia kadamba*		6.00	5.50
17	Bottle bush	*Callistemon lanceolata*			4.25
18	Baheda	*Terminalia bellirica*			3.00
19	Lasoda	*Cordia myxa*		7.00	11.00
20	Jungle jalebi	*Pithecellobium dulce*		3.50	
21	Amla	*Phyllanthus emblica*			5.00
22	Amrud	*Psidium guajava*			4.00
23	Aam	*Mangifera indica*			4.50

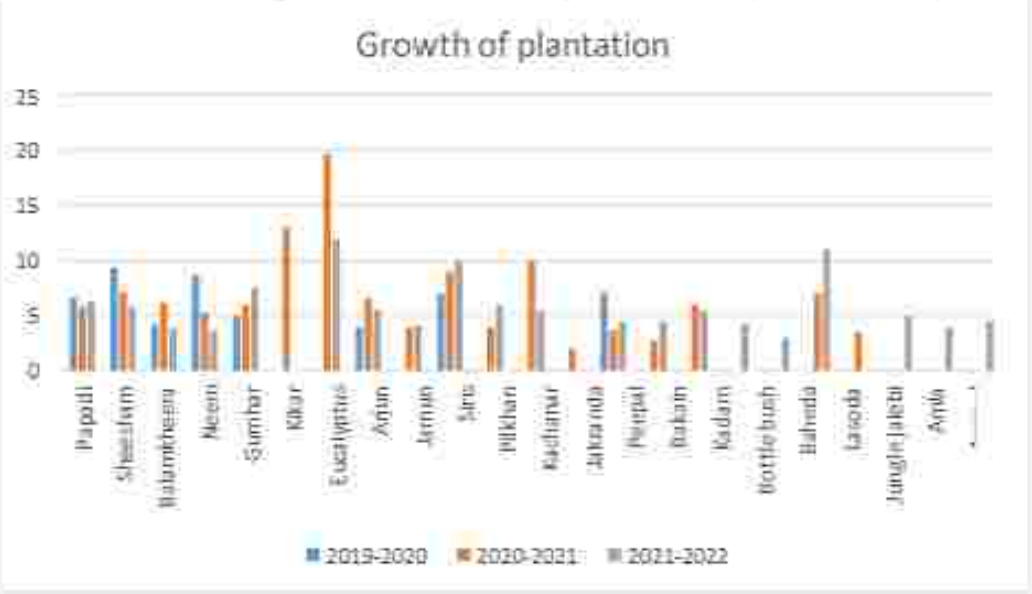

Figure 7.33. Average height of different plant species across three evaluation years

7.5.3. Sustainability

7.5.3.1. Protection measures

No forms of protection measures were found in the sampled plantation sites except RF Sekhpura. Barbed wire fencing was deployed to partially protect the plantation from grazing (Figure 7.34).

Figure 7.34: Barbed wire fencing at RF Sekhpura

The lack of adequate protection measures makes these plantation sites prone to the damage inflicted by grazing and browsing animals. Appropriate protection measures should be taken before conducting plantation activities to avoid damage to the plantation by grazing animals, trespassers, and unauthorized harvesting.

7.5.3.2. Maintenance:

The written information/evidence/records for maintenance/replacement of plants such as plantation journals, APOs, plantation maps, etc., have not been maintained in any forest range. This is one of the major shortcomings seen across the ranges of the Jhajjar division.

7.5.3.3. Monitoring

Chowkidars/watchers were appointed to manage the plantation activities (Figure 7.35). Huge areas were assigned to each of the chowkidars, which impacted the effectiveness. Assigning lesser areas could ensure better effectiveness and survival of the plantations. Some of the plantation sites were poorly maintained, and the plantations were covered by weed growth, in turn affecting the growth rate.

Figure 7.35: Chowkidar at the plantation site of Assandh-salvan road

7.5.4. Scoring of the plantations

The overall plantation activity was analyzed based on various parameters. Twelve different variables were identified based on which the scoring system was developed (Table 7.36). The plantation activity in Karnal division obtained a total score of 152.83 out of 250 (61.1%). The overall performance of the plantation is satisfactory considering immense grazing pressure and severe anthropogenic disturbances observed in most of the plantation sites.

Table 7.36: score obtained by the activities in Karnal division in various components

Sr	Year	Range	Component	Name of the site	Survival	Growth	Species suitability	Site suitability	Protection	Extent	Journal	Map	Invasive	Species composition	Weeding and hoeing	Watch and ward
1	2019-2020	Karnal	CA TP	RF Shekpura	88.06	20	10	8	20	20	0	0	10	10	0	10
2	2019-2020	Assandh	CA TP	RF Bassi Coup no 3 RF Bassi Tehssil Assandh	84.00	20	10	10	0	20	0	0	10	10	5	10
3	2019-2020	Assandh	CA TP	RF Bassi (5.27)	80.00	20	10	10	0	20	0	0	10	10	5	10
4	2019-2020	Karnal	NPV TP	Old Badshahi Canal RD Kutana - Bardari	69.00	20	5	10	0	20	0	0	0	10	0	10
5	2019-2020	Karnal	CA TP	Drain no.2 Naripal dera to Dadiana bridge	67.00	20	10	10	0	20	0	0	10	10	0	10
6	2019-2020	Assandh	NPV TP	Assandh to Sirsal road	57.20	20	10	10	0	20	0	0	10	10	0	10
7	2020-2021	Indri	NPV TP	Nardak distributary L&R	40.00	20	10	10	0	20	0	0	8	10	0	10
8	2020-2021	Assandh	NPV Ridge	RF Bassi	92.00	20	10	10	0	20	0	0	10	10	0	10
9	2020-2021	Assandh	CA TP	RF Bassi Coup no 5 & 6	85.00	20	10	10	0	20	0	0	5	10	0	10

10	2020-2021	Indri	NPV TP	Shambhali to Ramana road L&R	81.65	20	10	10	0	20	0	0	10	10	0	10
11	2020-2021	Assandh	NPV Ridge	Barota Channel	76.96	20	10	10	0	20	0	0	10	10	0	10
12	2020-2021	Assandh	CA TP	Gagsina Minor	72.10	20	10	10	0	20	0	0	10	10	0	10
13	2020-2021	Indri	NPV Ridge	Sarsu branch raod	68.00	20	10	10	0	20	0	0	10	10	0	10
14	2020-2021	Assandh	NPV TP	Assandh to Salwan road	61.23	20	10	10	0	20	0	0	10	10	0	10
15	2020-2021	Kamal	NPV TP	Kohand Assandh road 16-24km	53.12	20	10	10	0	20	0	0	5	10	0	10
16	2020-2021	Assandh	NPV TP	Amupur - Dhigtana	49.56	20	10	10	0	20	0	0	10	10	0	10
17	2020-2021	Indri	NPV TP	Indri scape L&R	45.76	18	10	10	0	20	0	0	5	10	8	10
18	2020-2021	Assandh	CA TP	Indri drain Karnal	45.64	20	5	10	0	20	0	0	8	10	0	10
19	2020-2021	Indri	CA TP	WJC main lower	27.66	20	10	10	0	20	0	0	5	10	0	10
20	2020-2021	Assandh	CA TP	G Drain-Assandh to SYL road L&R	25.00	20	10	10	0	20	0	0	5	10	0	10
21	2021-2022	Indri	NPV TP	Pakhana branch 0-sonkra rest house	56.00	20	10	8	0	20	0	0	10	10	0	10
22	2021-2022	Assandh	CA TP	BM Canal	94.00	20	10	10	0	20	0	0	5	10	0	10
23	2021-2022	Kamal	NPV TP	indri scape malnghat to sangoha pul	92.00	20	10	10	0	20	0	0	10	10	10	10
24	2021-2022	Assandh	CA TP	Karnal-Assandh road 16-36 L&R	86.45	20	10	10	0	20	0	0	5	10	0	10

25	2021-2022	Assandh	NPV TP	Kamal - Kaithal road 8-16	86.17	20	10	10	0	20	0	0	0	10	0	10
26	2021-2022	Kamal	CA TP	RF Shekpura & Indri Escape	82.00	20	10	10	2	20	0	0		10	0	10
27	2021-2022	Assandh	NPV Ridge	Chatang Drain	81.00	20	8	10	0	20	0	0	5	10	0	10
28	2021-2022	Assandh	NPV TP	Kamal - Kaithal road 24-32km	78.47	20	10	10	0	20	0	0	0	10	8	10
29	2021-2022	Kamal	CA TP	Indri escape	79.00	20	10	10	0	20	0	0	10	10	0	10
30	2021-2022	Kamal	CA TP	Kheri minor	77.77	20	10	10	0	20	0	0	5	10	0	10
31	2021-2022	Indri	CA TP	Newal chocyarna road	75.50	20	10	10	0	20	0	0	8	10	3	10
32	2021-2022	Assandh	NPV Ridge	RF Khandakheri	75.00	20	0	5	0	20	0	0	5	10	0	10
33	2021-2022	Indri	NPV TP	Indri scape Mvradgarh to Fagilpur	75.00	20	10	10	0	20	0	0	5	10	5	10
34	2021-2022	Kamal	CA TP	Old WJC road 22-29	72.05	20	10	10	0	20	0	0	0	10	0	10
35	2021-2022	Indri	NPV TP	Indri drain7-12	60.80	20	10	10	0	20	0	0	10	10	0	10
36	2021-2022	Indri	CA TP	Jamuna Bandh	45.60	20	10	10	0	20	0	0	10	10	0	10
37	2021-2022	Indri	CA TP	Sambhli minor	40.47	20	0	10	0	20	0	0	0	10	0	10
38	2021-2022	Indri	NPV	Salarpur road	29.76	20	10	10	0	20	0	0	0	10	0	10
39	2021-2022	Indri	NPV TP	Narwana Branch	5.04	20	10	10	0	20	0	0	0	10	0	10
					65.69	19.95	9.18	9.77	0.56	20.00	0.00	0.00	6.55	10.00	1.13	10.00

7.5.5. Non-Plantation activities:

7.5.5.1. Civil Works-Building

Table 7.37: Evaluated civil work site in Karnal Division

S.No.	Year	Range	Component	Name of Site	Description
1.	2020-21	Karnal	Building (Quarter)	Forester Quarter- 1 No.	The constructed building is in good condition, free from cracks, and damage, and fully compliant with the required standards.

Figure 7.36: Forester Quarter in Karnal Range

7.5.5.2. Effectiveness of the Civil Works (Building):

All the building works were found effective and compliant with the required standards.

Table 7.38: Effectiveness of the civil works

Sr. No.	Components	Effectiveness
1	Site Location	Good
2	Serving the intended purpose	Good
3	Structurally sound and free of cracks	Good
4	Free of dampness and leakage	Good
5	Overall finish and look	Good

Success story: Assandh to Sirsal Road (2019-20), Assandh

The plantation site of Assandh to Sirsal road implemented in 2019-2020 showed a remarkable performance with a survival percentage of 88.059 per cent.selection of sits and species to be planted played an important role in ensuring the success of the plantation. Majority of the plantation sites were near to agricultural land which positively benifited from the contant moisture presence, quality of soil, and periodic application of fertilizers. A total of ten different species were planted of which majority were fast growing. Chowkidar was appointed who also contributed towards the success.

8.Chapter 8: Development and Wildlife Wing

Although Haryana State is deficient in natural forests comparing to the other states, but it has rich bio-diversity, which makes it suitable for variety of wildlife particularly local and migratory bird species, and Blackbuck. The Development and Wildlife Wing Activities are spread across the state dedicated to conserving the biodiversity of the state.

These activities have been assessed based on the following criteria:

- 50% of value/sites have been assessed.
- 50% assessment of activities of Research, Seed, Training Division, and Publicity and Training Circle.

Table 8.1: Summary of Development Activities

Type	Expenditure covered	
	2020-21	2021-22
A. Research Division	41.23	7.1
B. Seed Division	257.73	10.5
C. Training Division	70.60	3.35

Table 8.2: Summary of Wildlife Activities

Divisions	2020-21		2021-22	
	Sampled Sites	Total	Sampled Sites	Total
Wildlife Division, Gurugram	14	24	16	30
Wildlife Division, Rohtak	2	6	4	7
Wildlife Division, Panchkula	2	3	3	5
Wildlife Division, Hisar	5	11	2	4

8.1 Assessment:

All the works evaluated under the Development and Wildlife Wing were found to be working adequately (Figure).

Table 8.3: Evaluated sample sites under Wildlife Wing

Sr No	Name of the Activity approved in APO 2021-22	Activities done during 2021-22	Proposed Amount	Expenditure	Balance	Effectiveness
1	Installation of Solar System at Rohtak & Bhindawas WLS	1. Installed Solar System at Bhindawas WLS. 2. Installed of Solar System at Rohtak in DWLO Office.	5.00	3.09	1.91	Effective
2	Installation of CC TV Cameras at Bhindawas WLS	CCTV installed at NIC, Rest House & Office of Inspector Wildlife	3.00	1.76	1.24	Effective
3	Construction of Inspector Wildlife Residence at Bhindawas	Due to heavy rain & water level in Bhindawas, the work was started late & could not be completed	20.00	11.06	8.94	Effective
4	Construction of Earthen bund to check entry hyacinth in pondage area 3.50 km at Bhindawas WLS	Due to heavy rain & water level in Bhindawas, the work could not be started	200.00	0.00	200.00	Effective
5	Construction of Mounds in Bhindawas WLS	Due to heavy rain & water level in Bhindawas, the work could not be started	25.00	0.00	25.00	
6	Construction of Water Pond-3 No @ 2.50 Lakh (WLS NAHAR) = 7.50 lacs	Construction of Water Pond- Part-1st-east-side, Part-1 B,Part1-A in WLS NAHAR.	750000	740208	9792	Effective
7	Fixing of PVC Pipe Line for water supply approx 1500 mtr.(WLS NAHAR)= 3.00 Lacs	Fixing of PVC Pipe Line for water supply approx 1500 mtr.(WLS NAHAR)	300000	287794	12206	Effective
8	Preparation of Sandy Mound-6 No (WLS NAHAR) =4.50 Lacs	Sandy Mound 7 No at WLS-Nahar	450000	442749	7251	Effective
9	Removal of mesquet (WLS NAHAR) = 6.00 Lacs	Removal of Musquite 125616 Sqm	600000	597933	2067	Effective
10	Development of Grass Land (WLS NAHAR) = 5.00 lacs	Development of Grass Land (WLS NAHAR)	500000	478240	21760	Effective

11	Construction of Store @ 10.00 Lakh = 10.00 lacs Construction of Garage at Gurugram side by DWLO Gurugram Office instead of WLS Nahar. Please give deviation (WLS NAHAR) = 10.00 lacs	Construction of Garage cum store (WLS-NAHAR) Rewari=1011506/- & Gurugram =982654/-	2000000	1994160	5840	Effective
12	Clearance of fire lines & maintenance (WLS NAHAR) = 5.00 lacs	Clearance of fire lines & maintenance (WLS NAHAR)	500000	484296	15704	Effective
13	Development of Fooder Plot-2 No (WLS NAHAR) = 2.00 lacs	Development of Fooder Plot-2 No (WLS NAHAR)	200000	199920	80	Effective
14	Fencing of Path Iron on Jali & Painting in Nahar WLS Nahar & SNP = 8.00 lacs	Providing & Fixing of M S Flate 9039 Kg	800000	807375	-7375	Effective
15	Creation of New Lawn in Campus (WLS NAHAR) = 2.00 lacs	Creation of New Lawn in Campus (WLS NAHAR)	200000	136630	63370	Effective
16	Interlocking tiles inspection path inside the fencing 2470 runing meter (P&CBC Jhabua) = 30.00 lacs	Constraction Of Inspection Path at P&CBC Jhabua 2837.5 Sqm,28 Mtr Const. of Path at WLS-Nahar	3000000	2996677	3323	Effective
17	Weed removal (Congress grass) from Protection center in 10 Acre (WLS NAHAR) = 5.00 lacs	Weed removal (Congress grass) from Protection center in 10 Acre (WLS NAHAR)	500000	495022	4978	Effective
18	Plantation of Fruit Plant Species (WLS NAHAR) = 15.00 lacs	Plantation of Fruit Plant Species (WLS NAHAR)	1500000	1491750	8250	Effective
19	Construction of Boundary Wall with fencing in 2nd part 3600 R.mtr (WLS NAHAR) = 40.00 lacs	Construction of Boundary Wall with fencing in 2nd part 3600 R.mtr (WLS NAHAR)	4000000	3999058	942	Effective
20	Interlocking tiles path main gate to SIWL office & Protection Center at WLS nahar = 3.00 lacs	Const. of Path at WLS-Nahar	300000	278620	21380	Effective
21	Construction of Boundary Wall (600 mtr. At WLS Nahar-Part-11)	Construction of Boundary Wall (600 mtr. At WLS Nahar-Part-11)	1876000.00	1876000.00		Effective
22	Extension of Protection Centre (23 Acre to 40 ace=17 acre) to provide	Extension of Protection Centre (23 Acre to 40 ace=17 acre) to	1291000.00	1291000.00		Effective

	proper space to the black bucks om WLS Nahar	provide proper space to the black bucks om WLS Nahar				
23	Constuction of IWL Office at Mahendergarh and Faridabad (instead of Nuh)	Constuction of IWL Office at Mahendergarh and Faridabad (instead of Nuh)	5956000.00	5956000.00		Effective
24	Constuction of IWL Residence at Mahendergarh	Constuction of IWL Residence at Mahendergarh	1402000.00	1402000.00		Effective
25	Constuction of Guard Hut at WLS Nahar and Gurugram Forest Complex (instead of Rewari)	Constuction of Guard Hut at WLS Nahar and Gurugram Forest Complex (instead of Rewari)	2077000.00	2077000.00		Effective
26	Procurement of Rescue Equipments for Rescue Team	Procurement of Rescue Equipments for Rescue Team	235000.00	235000.00		Effective
27	Procurement of Rescue vehicle with modification 2 No.	Procurement of Rescue vehicle with modification 2 No.	1518000.00	1518000.00		Effective


Latitude: 29.192046
Longitude: 25.759117
Elevation: 224.55±28m
Accuracy: 3.0 m
Time: 25-09-2023 13:22

Figure B.1: 1) Water pond, 2) Lawn, 3) Inspection pathway, 4) Water pond, 5) Boundary wall, 6) Inspector residence, 7) CCTV, 8) Sandy mounds, 9) Plantation of fruit plants, 10) Garage cum store, 11) Shelter Home in Deer Park, 12) Feeding Platform

9. Chapter 9: Analysis of the design of CAMPA Plantations in Haryana

'What to plant', 'where to plant' and 'how much to plant', are key decisions that need to be carefully evaluated based on ecological principles and needs of local communities rather than on survival percentage or growth potential. Planning an afforestation project must consider the key performance indicators to focus not only on survival and growth but also on the suitability of site for tree planting, species selection and active community involvement. Selecting deforested planting sites, adapting the plantation design by accounting for the threats, locality factors and preferring native species can significantly enhance ecosystem restoration and biodiversity conservation. Based on this global literature review and field experience gained from the field exercise in CAMPA plantations in Haryana, we discuss the aspects of the programme design that need to be strengthened and provide suggestions that we hope will be adopted in the next phase of this initiative.

9.1. Addressing the drivers of degradation before planting

In sites where the rate of biomass removal (grazing, harvesting, firewood collection etc.) is faster than primary production, it is imperative to address the livelihood needs of the local community before afforestation (or restoration) is attempted. Afforestation projects implemented in isolation without addressing the causes and drivers of deforestation in consultation with the local community will remain a 'band-aid' approach to degradation and not provide a lasting cure (Blignaut 2009).

Figure 9.1: Drivers of degradation- Stubble burning and unsuitable edaphic conditions

The drivers of degradation such as over-grazing, tree felling, forest fires, the tragedy of the commons, infestation by invasive species, weak enforcement, etc. in the proposed restoration sites need to be identified and plantations should commence only when these have been effectively addressed. The most apt way would be to involve and consult with the local communities in site identification, species selection execution and protection leading to restoration so that they develop a sense of ownership.

In Samhalkha Range of Panipat division, the Range Officer Mr. Virender proactively approached the local communities and consulted with them regarding the species and site selection. He also asked the landowners adjacent to plantations to occasionally irrigate the plantations and explain to them the importance of the afforestation initiative. As a result, the damages to the plantation caused by grazing and agricultural burning have reduced significantly.

Figure 9.2: Drivers of degradation- Abundance of invasive species such as Lantana camara and Parthenium hysterophorus

Figure 9.3:Drivers of degradation- Cattle grazing is the main reason behind stunted saplings in many plantation sites

We suggest that the prescribed plantation models need to factor in the ground situation. The main causes of plantation failure are grazing, drought, frost, fire, floods, local disturbances etc. These threats existed even before the plantations were planned, and addressing these threats using mitigation and adaptation measures should be made a precondition before the plantation is taken up. In sites, where this is not possible, plantations should not be taken up as they will probably meet the same fate as the original forests that got degraded. The second option is to adopt a mitigation strategy wherein the design of the plantation model adequately takes into account these threats and risks such as mound plantations in water-logged areas, selecting species that can withstand water logging, effective fencing in grazed areas, community partnership and ownership, provision of watering during summer and winter etc. Freedom and flexibility need to be provided to the forest divisions to include these components in the existing plantation models based on site-specific threat perception and locality factors.

9.2. Deploying adequate protection measures

Proper protection measures are necessary to protect the plantation from various anthropogenic disturbances such as grazing, illegal cutting, littering etc. Perimeter fencing with barbed wire or Cattle Proof Trench (CPT) is mostly opted for, but with a fewer number of saplings, the tree-specific bamboo gabion is more effective and ecologically sound. In the 6 divisions of South Circle, very few sites were found with complete or even partial perimeter fencing. Only one site, in the Faridabad division, has tree-specific fencing (bamboo gabion) in areas with higher disturbances.

From the Key Informant Interviews, we got the information that the fund allocated to fencing comes months, even in some cases years, after the plantation. In some ranges, no funds were allocated to perimeter fencing, leaving the plantation unprotected and vulnerable to anthropogenic disturbances.

After observing the plantation sites, we suggest that in the case of a roadside plantation, fewer plants should be planted with better protection measures to ensure the survival of the plantation. In the case of a block plantation, Barbed Wire fencing in non-forested land and Cattle Proof Trench in forested land should be adopted.

9.3. Protecting natural open landscapes from afforestation

A deep misunderstanding exists about grass biomes, as well as their denigration and devaluation relative to forests (Veldman et al., 2015). Open natural ecosystems such as grasslands, wetlands, etc. must be excluded from tree plantations, as it would lead to change in their fundamental character. Solely relying on remote sensing and GIS studies for identifying potential plantation sites without adequate ground truthing can be misleading. It is suggested that forest expansion should be strictly avoided in sites where historically they did not harbour forests and instead reforestation should be carried out by planting trees on deforested lands.

9.4. Plantation species mix should be reshuffled

In most of the sites, native species like Papdi, Sheesham, Arjun etc. were planted. But Focus Group Discussions and Key Informant Interviews revealed that instead of Papdi (*Holoptelea integrifolia*), hardy species like Lasoda (*Cordia myxa*), Kikar (*Acacia nilotica*), Khejdi (*Prosopis cineraria*), Reunjh (*Acacia leucophloea*) also can be added to the existing species mix. All these species can withstand frost, grazing, and extreme dry weather. These species are also likable to the local people. Instead of just increasing the green cover, we should focus on creating a balanced ecosystem where the local biodiversity can be restored and conserved.

9.5. An achievable target should be given to the forest ranges

Our data revealed that in many forest ranges, unrealistically large targets were given and the forest ranges were forced to carry out plantations in unsuitable areas. Due to the lack of suitable areas and huge targets, sites with an abundance of invasive species and severe anthropogenic disturbances were selected. As a result, 2-4-year-old saplings were found to be stunted due to intense grazing. The concerned range office should be consulted regarding the target area and species before the initiative. According to the key informants, fewer saplings in a suitable site with adequate protection measures will produce excellent growth and survival.

9.6. Record keeping needs to be strengthened

Record-keeping was found to be inadequate in almost all the sampled sites. The actual ownership of the sites were not verified due to the lack of proper documents. The number of replaced samplings also could not be verified. Most of the divisions in all four circles do not have any plantation journal, measurement book or estimates. The plantation sites on the ground also lack any kind of demarcation (plantation board), which created difficulties to identify and verify the sites from the APO.

It is highly suggested that plantation journals in the prescribed format should be maintained and kept updated to enable effective monitoring and evaluation. The plantation journal needs to include a site map, soil details, plantation polygon points, pits dug, the species-wise breakup of plants planted, breakup of a site into sectors/patches, process photos etc. Internal inspection reports of supervising officers also need to be entered into these registers. Maintaining these journals should be made a mandatory requirement and their quality checked before final payments for the works are released. Also, the geo-referenced plantation polygon of the perimeter of the plantation as a KML file should be diligently recorded and stored with the division office for future reference. This will enable better monitoring and evaluation as detailed documentation of the works is readily available. Proper plantation board with name, area, co-ordinates and species planted should be installed in every plantation site to avoid any unwanted complications in identifying the site.

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11. Annexture: Evaluation Formats

A. PLANTATION DETAIL FORM

Name of plantation site: Date:

Division		Forest Range	
Forest Block		Forest Beat	
Compartment No:		Legal status of site	
Location	Lat. – Long.-		
Name of Component		Physical Target/Numbers of plants planted per unit	
Year of Plantation/Activity		Whether plantation map prepared	
Area of Plantation/Activity recorded		Actual area using GPS	
Name of Evaluator		Designation of Evaluator	
Dates of Evaluation			
Signature of the officials	Name: Designation:	Name: Designation:	Name: Designation:

B. PLANTATION EVALUATION FORM

Site Name: Component:

Date Range: Division:

Plot No.	GPS coordinates of the plot	Species	Spacing	Plants planted	Condition of plants		H (feet)	G (cm)
					Live	Dead		

Evaluator 1: Evaluator 2:

C. PHYSICAL VERIFICATION OF ACTIVITIES

Fencing (for each Plantation unit sampled)

	Barbed wire Fence					
Date	Name	Length in Measurement Book	Actual Length	variation (+/-)	Present status – Intact / Wornout	Effectiveness

Chain Link Fence					
Chain Link Fence Id / No./Name	Height x Length in Measurement Book	Actual Size (HeightX Length) in field	% variation (+/-)	Present status – Intact / Worn out	Effectiveness of theFence (very effective/ moderately effective/not effective

Signature of the Officials

Signature of the evaluator

D. SOIL AND MOISTURE CONSERVATION MEASURES (SMC)

DRSM/Crate/WHS				
Date	Name	Size in Measurement Book	Actual Size (Width * Depth* Length) in field	Expenditure

E. KEY INFORMANT INTERVIEW (KII) WITH FOREST STAFF

Name of Plantation:		
Year of plantation:	District:	Division:
Range:	Forest Beat:	Compartment:
Name of staff:		
Official Post:		
Interview date:		

A. PLANNING

1. What was the past natural vegetation of the plantation site?

a) Dense forests **b)** Open forests **c)** Degraded forests **d)** Grasslands **e)** Others (please give details)

2. What was the status of the plantation site before plantations were taken up?

a) Degraded land of not much use to the village **b)** Used for grazing of village cattle

c) Used for firewood collection **d)** Others (please give details)

3. What was the main reason for selecting this site for afforestation?

a) Degraded status **b)** Demand from the villagers/JFMC **c)** Good working relationship with the local community **d)** Good past experience in the locality **e)** Good site quality

f) Others

4. Was the site selection verified by senior officials? (yes/no)

5. How were the plantation species identified?

a) Demand from the villagers/JFMC **b)** Good past performance in the locality **c)** Departmental norms **d)** Naturally occurring in these forests **e)** Others (please give details)

6. What was the reason for selecting the plantation protection measures?

a) Demand from the villagers/JFMC b) Departmental norms c) Good past experience in the locality d) Others (please give details)

7. Was there a provision kept for irrigating the plantation during the dry season?

a) Yes, by using tankers b) No provision for irrigation c) Others (please give details)

If no, why?

8. What was the strategy to protect the plantation after planting?

a) Bagarh b) Live hedge c) Cattle proof trench d) Cattle proof dry stone wall e) Barbed wire fencing f) Chain link fencing g) Employing chowkidar h) Others (please give details)

9. What were the main challenges/ limitations you faced in the planning phase?

a) Less time for detailed field survey b) Limited staff for detailed field survey c) Limited funds for detailed field survey d) Lack of equipment and tools e) Others (please give details)

B. IMPLEMENTATION

10. Where were the seedlings for the plantation sourced from?

a) CAMPA nursery b) Private nursery c) Adjacent forest areas d) Others (please give details)

11. What were the type of seedlings used?

a) Bare root seedlings b) Polybag seedlings c) Root trainer seedlings d) Others (please give details)

12. What was the average height of the plants planted _____(feet)

13. What was the type of fencing used to protect the plantations?

a) Bagarh b) Live hedge c) Cattle proof trench d) Cattle proof dry stone wall e) Barbed wire fencing f) Chain link fencing g) Employing chowkidar h) Others (please give details)

14. What were the main challenges/ limitations you faced in the implementation phase?

a) Lack of adequate labour b) Limited staff for supervision c) Poor quality of seedlings d) Delay in planting e) Lack of adequate funds f) Others (please give details)

C. MAINTENANCE

15. Which plantation species were affected the most?

_____

Give reasons why?

16. What is the status of natural regeneration in the plantation site?

a) Excellent b) Moderate c) Poor d) Absent

Give details of species and reason?

17. Was the fencing of _____used effective? (yes/no)

_____

Give reasons why?

18. What were the main challenges/limitations you faced in the maintenance phase?

a) Lack of adequate irrigation b) Limited staff for supervision c) Lack of adequate watch and ward d) Cattle grazing e) Lack of adequate funds f) Forest fire g) Others (please give details)

D. OVERALL PERCEPTION

19. What is your perception of the survival percentage? _____%

20. Which plantation species have performed well and which have not performed well?

Give reasons why?

21. Are you satisfied with the overall plantation activity?

a) Fully satisfied b) Largely satisfied c) Not satisfied d) Don't know

22. What is the perception on future perceived benefits to the local community from these plantations?

23. What was the most difficult part of this afforestation project?

24. What are your suggestions to improve the effectiveness of future plantations?

Name of the interviewer:

Signature: Signature of the interviewee:

F. FOCUS GROUP DISCUSSION

Plantation site: Date:

Range: Division:

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1. Whether the dialog deliberations with the local communities took place before the plantation initiative

2. Did the FD arrange any awareness programs or community meetings during the plantation program?

3. Your opinion on the species chosen for the restoration/afforestation initiative

4. Your opinion on the sites chosen for the restoration/afforestation initiative

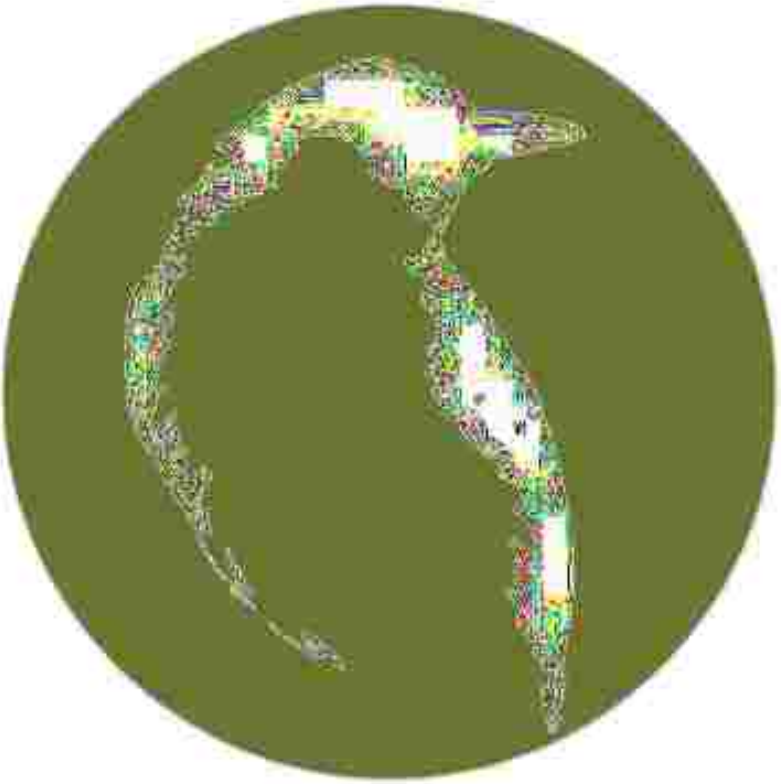
5. Drivers of degradation identified during the survey

6. In case of livestock grazing or stubble burning or any other drivers where the community is involved, what did FD do to protect the plantation?

7. What could be your possible contribution to secure the survival of the plantation?

8. Your suggestions for a future afforestation initiative:
   - In terms of species selection
   - In terms of site selection
   - In terms of monitoring
9. How the community involvement in forestry interventions could be better?

Name of the participants **Name of the officials**



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