उत्तराखण्ड प्रतिकरात्मक वनरोपण निधि प्रबन्धन और योजना प्राधिकरण (उत्तराखण्ड कैम्पा)
UTTARAKHAND COMPENSATORY AFFORESTATION FUND MANAGEMENT & PLANNING AUTHORITY (UK CAMPA)
(प्रतिकरात्मक वनरोपण निधि अधिनियम, 2016 (2016 का 38) की धारा 10(1) के अंतर्गत भारत सरकार द्वारा अधिसूचित
(Notified by Govt. of India under the section 10(1) of the Compensatory Afforestation Fund Act, 2016 (38 of 2016)
85–राजपुर रोड, देहरादून, उत्तराखण्ड– 248001: दूरभाष/फैक्स : 0135–2744077
85-Rajpur Road, Dehradun, Uttarakhand – 248001 Tele/Fax: 0135-2744077 Email: ceocampa-forest-uk@nic.in, Website :www.ukcampa.org.in

Letter No.- 873 /GoI /2024-25 Dated 19 February, 2025

To,

CEO, National Authority,
Compensatory Afforestation Fund Management & Planning Authority
(CAMPA), MoEF&CC, Government of India
3rd Floor (Front Portion),
Supreme Court Metro Station Building (Line-3),
New Delhi – 110001, Email: nationalcampa-moefcc@gov.in

Subject: Monitoring Mechanism– reg.
Reference: Your letter F. No. 1/16/2023-NA dated 13.02.2025

Sir,

In reference to above, a brief note on the monitoring mechanism adopted in the State of Uttarakhand for monitoring of works carried out under CAMPA is being enclosed.

Kindly note that the Monitoring & E valuation of activities implemented between 2017-18 to 2020-21 is currently under progress and is being done by the team of Indian Institute of Forest Management (IIFM), Bhopal. The report thereof, is expected to be received by the end of current financial year 2024-25.

With warm Regards

Yours sincerely,

End: As above

(Dr. Samir Sinha)
PCCF & Chief Executive Officer
Uttarakhand CAMPA

Monitoring Mechanism

Name of State: Uttarakhand

Internal Monitoring and Evaluation Mechanism, Uttarakhand

There is a multilayered Monitoring and Evaluation (M&E) arrangement adopted in the State of Uttarakhand for monitoring of CAMPA related works.

Concurrent Monitoring:

The Concurrent Monitoring is primarily done by the Division level Officers of the Implementation agencies. Second level of Monitoring is carried out by Conservator of Forests. Moreover, concerned zone level officers (CCF/Addl. PCCF) and other higher officers also conduct monitoring of undertaken works in CAMPA from time to time. The findings and comments of such field visits are mentioned in the inspection notes. The comments are mostly related to the quality of work and suggestions for any improvements.

Monitoring of ongoing works, however, is a regular feature where, under an internal mechanism of CAMPA office, progress of achievement of the approved APO is regularly monitored by the Chief Executive Officer. The status of expenditure and deliberations on quality of work is also being regularly monitored in review meetings of CAMPA works by CEO and PCCF (HoFF) as Chairperson of the Executive Committee. Further, the progress of previous and current financial year is also presented before the Executive and Steering Committee in the scheduled meetings.

Internal Monitoring:

A designated Monitoring, Evaluation and Audit Wing is already established under the Uttarakhand Forest Department headed by CCF, M&E and audit, Uttarakhand. The monitoring wing has an independent mechanism for monitoring & evaluation in parity with the standards. The monitoring wing carries out the monitoring of Compensatory Afforestation and other plantations, SMC works, nurseries, etc. executed using CAMPA Funds and other State schemes. On the basis of monitoring Reports CEO, Uttarakhand CAMPA and other higher officers evaluate the progress pertaining to timelines and direct concern officers to ensure and comply with necessary corrective actions/measures.

General mechanism adopted by CCF, Monitoring & Evaluation, Uttarakhand is as under:

- The evaluation work in the State mainly follows the monitoring methods for assessment of plantations, advance soil work, nurseries, SMC/other engineering works etc. implemented under different schemes, including CAMPA.
- For evaluation, 03 years old plantations are selected.
- Information on works carried out under different schemes is obtained from forest divisions on 1-10 formats (plantations, nurseries, advance soil works, engineering works etc.)
- Selection of approximately 30 percent area of plantation site under different schemes is made and counting all part of the selected plantation area/plot is done.
- The selection of plantation areas is made through Stratified Random Sampling giving due preference to plantations raised by different forest divisions in different forest ranges. Sampling is done through a computer application using Rand Function=rand() giving preference to the higher random no.

- Apart from plantations, monitoring is also carried out for activities like advance soil works, engineering works, nurseries etc.
- For CAMPA works evaluation work is carried out by the monitoring team by selecting 30% areas and the monitoring report is sent to PCCF (HoFF), Uttarakhand; CEO, Uttarakhand CAMPA; concerned CCF (Zonal Chief) and CF (circle head) for necessary action and also to the concerned forest division for compliance of the indicated shortcomings.

Common Corrective/Suggestive Measures in Internal Monitoring

1. Regular weeding and bush cutting exercise should be carried out in plantations etc. works being done under CAMPA and data related to the survival percentage of the plantations should be entered in the plantation journal every year.
2. The documents related to plantations should be maintained properly. These should be updated from time to time and made available when asked for.
3. For protection of plantations, adequate arrangement of plantation chaukidars should be done.
4. The fencing created around plantations for protection should be regularly maintained.

Third-Party Monitoring:

Third Party Monitoring of CAMPA works is to be carried out in compliance of Para 5(3)h of the Compensatory Afforestation Fund Rule-2018. It is in addition to the periodic monitoring conducted by the team of CCF, M&E, State Forest Department. The agency is chosen either through a competitive bidding in the open market or through a competent third party government agency working in similar field following the norms of the prevalent procurement rules in the State.

Monitoring by Forest Research Institute (FRI), Dehradun:

In compliance of the above, the first drive of third-party monitoring was entrusted to Forest Research Institute (FRI), Dehradun for monitoring of activities implemented in the State using CAMPA fund between 2010-11 to 2016-17. The work was awarded to the institute in FY 2016-17 while the monitoring was conducted in 2018, 2019 and 2020 and final report submitted in 2021. The methodology adopted by the institute for monitoring is as given below:

Methodology adopted:

Monitoring and evaluation work under afforestation schemes have been carried out by selecting sample plots in each site of forest range considered as a unit. Moreover, the size of plots and category of plantations was also taken into consideration for representation of all units. The random sampling strategy was adopted for the selection of sample plots in all study Forest Divisions. The selected plantation sites were traversed and area of the plantations were verified by recording the GPS locations. GPS points of each sample plot in the sites are recorded and presented in the formats of annual reports. Fifty percent of the sites were selected for monitoring of the total plantation sites and 10% of the plantation's area of each sample site was selected for data collection. However, more than 10% area was also selected depending on the sample size.

The areas of all plantations' sites were surveyed for verification of actual area with the help of GPS. The difference in the area is shown in the division's tables in chapter-5. In each patch up to size of 5 ha, five sample plots of 0.1 ha were laid, in patch of 10 ha, ten plots of 0.1 ha were laid, in case of patch with area 15 ha, 15 samples plots, and for 20 ha size, patch a total of 20 sample plots

were laid for monitoring. If the plantation is carried out in rows or strips along the roads or canals, a row of 100 m length of plantation was treated as a one sample plot.

The sample plots were randomly selected in the following manner:

1. The sample plots proportionately allocated into each division so as to cover the scheme and its components.

2. Selected plantation area or site was examined for area accuracy with the help of GPS by way of traversing around the boundary of the plantation.

3. Within the plantation patches plots of 0.10 hectare size 31.62m x 31.62m were laid in rectangular or square shape as per field convenience to assess survival and growth parameters of plants as per format.

4. In small plantation area up to 5 hectares, five plots of size 0.10 hectare were laid at designated places.

5. In selected area of 10 ha, ten plots were laid out at designated places. The selection of 2nd patch was randomized to avoid biasness.

6. For plots of 20 ha, 20 plots were laid out at designated places. The selection of patches was randomized to avoid biasness.

7. If the plantation is carried out in rows or strips along the roads or canals, a row of 100 m length of plantation was treated as a one sample plot.

Indicators for Monitoring and Evaluation:

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

The major Indicators for data collection are provided below:

1. Plantation scheme and its components
2. Choice of species in the sites
3. Selection of the planting site
4. Planting methods
5. Size of the pits/trenches including earth work done
6. Spacing of the pits

7. Time of planting
8. Health of the plants
9. Cultural operations (Hoeing, weeding, soil working etc.)
10. Protection status of the plantation
11. Management of plantations (causality replacement, watering, pruning, thinning etc.)
12. Growth and survival of plants

Collection of field data

The data was collected for plantation work carried out under UK-CAMPA and its components viz., NPV and CA during the period from April 2018 to February 2021. The parameters used for assessing the plantation works were choice of species with respect to the requirement of sites, local communities need/perception about the species, readiness of planting such as cleaning and preparation of sites, advance pitting for proper weathering, temporary arrangement for storage of seedlings and arrangement for irrigation before planting, soil working and weeding immediately after planting and causality replacement of plant if required. In addition to above the ecological aspects such as soil and water conservation activities undertaken under the scheme in different plantations sites were also observed to understand their impact at these sites. Efforts were also made to understand the socioeconomic issues in terms of fuel and fodder supply and improvement in water table by interacting with local people.

Biodiversity aspect of the plantation activities were also recorded by conducting vegetation analysis in plantation sites and presence of wild fauna during the survey. The data for the monitoring and evaluation of the plantation sites were collected by a multidisciplinary team with experts from disciplines such as Silviculture, Ecology, Soil science etc as per requirement of the site. The collected data were compiled, tabulated and then analyzed for the preparation of the final report.

Compilation and analysis of field data

The data collected from different teams of FRI were compiled and tabulated. The field data of each site was compiled range wise. The survival of plants was calculated by using data on number of plants of each species planted from the plantation's journals to the actual number of plants observed in the fields. The average height and diameter of each species are compiled for observation of growth of plants.

General Field Observations

1. Stone wall fencing was created in most of the plantation's sites for the protection of plants as the stones are easily available in hilly areas. In the plains, some sites were found protected from barbed wire fencing. In wildlife areas, trenches around plantation sites were dug. However, fencing was not found effective in protection of plants against wild animals such as wild boar, bear, porcupine, elephants, deer, ghoral etc. The fencing was found broken at several places. The fencing trenches were filled with soil and invasive species like lantana and grasses have found grown. Domestic cattle of villagers are also caused damage to plants due to grazing and trampling. Although watchers were engaged but still plants were damaged.

2. Forest fire incidents occurred in plantation areas during fire season. Plants were also found killed by forest fires. Fire protection measures were not found sufficient in many sites.

3. The plantation was under heavy anthropological pressure due to presence of nearby villages.

4. Regeneration of banj, burans, mehal, shisham, chir, deodar, sal etc. was observed in plantation's sites which require to be protected and enhanced under CAMPA activities.

5. The recorded plantation's area mentioned in the plantation journal was found less than the area measured by GPS during field survey in many sites.

6. Weeds like Karonda, Eupatorium, Tungla, Dhola, Rambans, Lantana, Ageratum, Parthenium, Hisalu, Tiliari etc. were invading in most of the plantation's sites. At riverain sites, kan (Saccharam) grass has suppressed plants in Haridwar and Dehradun Forest Divisions.

7. Survival of plants was found to be satisfied in wildlife protected areas than other areas.

8. Soil erosion is a common feature on higher slopes. Gully plugging in those areas is carried out by construction of series of check dams with the help of local materials like boulders or chir needles. However, check dams and water harvesting ponds (chaal-khaal) were not maintained. Soil and water conservation measures like trenches, contour bunds or terraces were not made for soil and moisture conservation in sloppy areas. Landslide and soil erosion is a common feature in such sites.

9. Some of the sites were not found to be suitable for the species. Such sites are having shallow soils, rocky and very low moisture and nutrient contents. Site selection for plantations under CAMPA should be selected after thorough technical investigation.

10. On hilly terrain, spacing of plants was not accurate as mentioned in plantation journals but in the plain areas, spacing of plants was found correct.

11. The Plantation Journals of each site were available but there no inspection notes of senior officers found in the journals.

Lesson Learned and General Recommendations

From the available evidence, the monitoring of plantations conducted by FRI, Dehradun concluded that the schemes viz., CAMPA was able to contribute substantially towards the State and central government goal of enhancing forest cover and reclamation of degraded lands. The project activities will result in positive environmental impacts and will also result in enhancing biological richness.

Monitoring by Indian Institute of Forest Management (IIFM), Bhopal:

The 2nd phase of Monitoring of CAMPA works in Uttarakhand has been entrusted to Indian Institute of Forest Management (IIFM), Bhopal for activities implemented between 2017-18 to 2020-21. The task was awarded to the institute in FY 2023-24. The monitoring team of the institute has already collected the field data and report writing work is currently underway. The report is expected to be received by the end of FY 2024-25.

Proposed methodology

Evaluation framework

The evaluation will broadly follow the six-dimensional approach of measuring relevance, effectiveness, impact, efficiency and sustainability, coherence (IFAD, 2009).

Figure 1. Six-dimensional approach for evaluation (IFAD, 2009)

Among the six criteria as depicted in Fig. 1, the present evaluation will cover the dimensions of relevance, effectiveness, impact, efficiency, and sustainability by measuring different field variables such as site suitability, species selection, growth, survival, habitat and livelihood improvement, etc.

Relevance concerns the extent to which an initiative and its intended outputs or outcomes are consistent with the needs of the environment and the intended beneficiaries. Relevance in this context will measure the extent to which the plantation activity is suited to the environment and the intended beneficiaries. Two physical variables namely site suitability and species selection will be measured. The evaluation will also explore the extent to which the planning, design and implementation take into account the local context in terms of needs of the local community and the environment.

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, growth and survival will be measured.

Impact measures changes in human development and people's well-being that are brought about by development initiatives through plantation, 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. In this case, perceived future benefits will be reported considering secondary literature on ecosystem benefits. Ecological impacts of the plantation in terms of soil and water conservation, biodiversity enhancement etc. will be thus examined in the project.

Efficiency includes a measure of how economically inputs (funds, expertise, time, etc.) are converted into results. Measuring efficiency will include an assessment of financial aspects such as costs and benefits and will be achieved through a financial Benefit Cost Analysis.

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. For this component, the prospects of future survival of the plants will be assessed based on risks like droughts, grazing, fire etc.

Site selection

The plantation sites will be selected following stratified random sampling using forest division, year of plantation, and nature of activity as strata. As per the sampling requirements specified by State CAMPA, 10% of the total area in each division will be sampled, making sure to cover not less than 30% of the sites in the individual forest division. Therefore, the sampling will cover plantation activities (serial no 1 to 7 in Table 1) of 6575 ha, linear activities spanning 53 km and 407 numbers of point activities, spread in around 3847 sites (30% of the total sites).

Sampling procedure

A stratified random sampling procedure will be used for evaluating the plantations. For this, a 25 x 25 m quadrate will be laid out in the level ground (IIFM, 2016) and a 15 x 15 m quadrate will be laid out for sites located in the steep slopes (IIFM, 2022). For linear plantations the sampling is carried out by laying segments of 50m length for every 500 m in a systematic manner.

The following is the diagrammatic representation for the distribution of the sites and selection of the plots for block and linear plantation. A second stage of sampling will be applied in each study site to select maximum 5% of plants at each site for measurement.

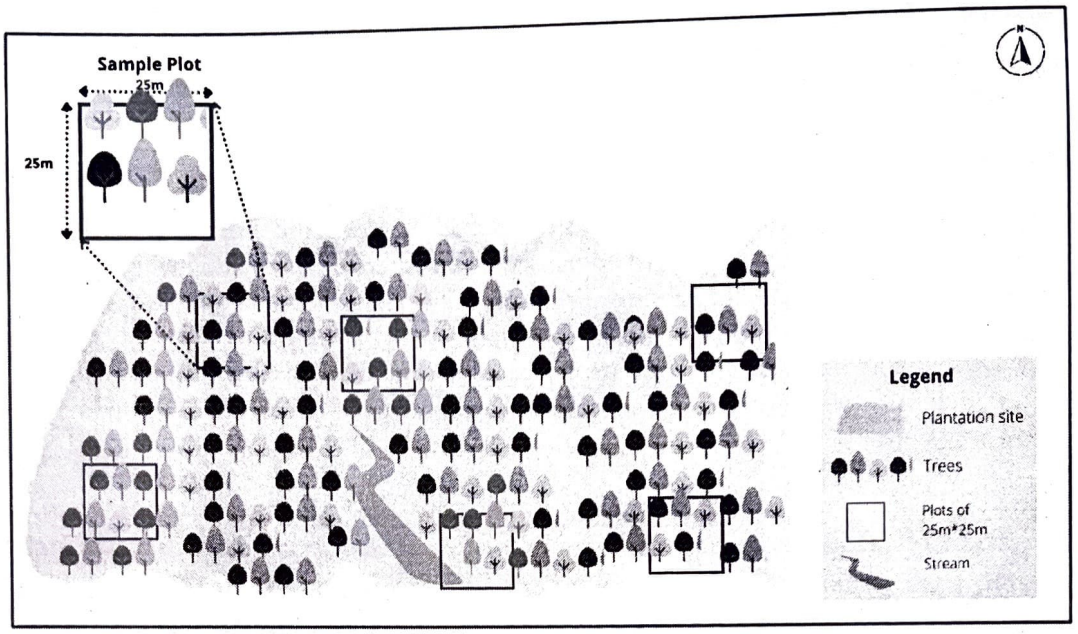

Figure 2: Area-based sampling within a plantation site is carried out by laying square grids of 25m x 25m in a representative manner

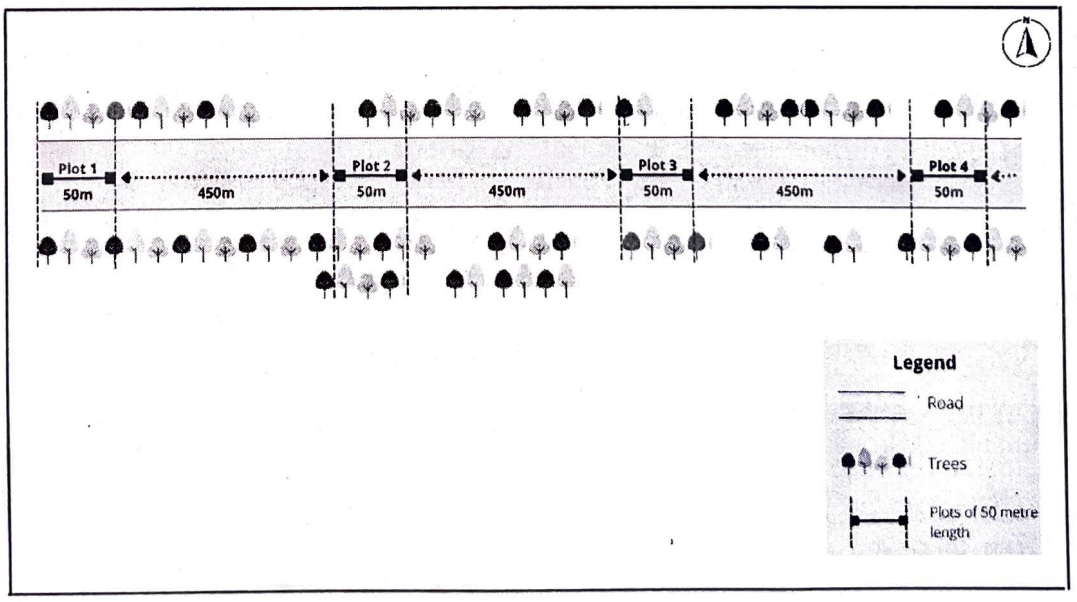

Figure 3: For linear plantations the sampling is carried out by laying sampling segments of 50m length for every 500m in a systematic manner.

Sampling in the areas of linear afforestation sites

The plantation length will be traversed to generate the geo-referenced plantation arc. The linear length of the plantation in km can be verified this way. Every 10th plant in the traversed line will be measured and the survival percentage of the study area will be calculated.

Sampling in a block plantation site

The plantation perimeter will be traversed to generate the geo-referenced plantation polygon (Fig 2). The afforested area will be divided into grids of 50 m x 50 m and the samples drawn along the traversed line. The plantation area will comprise of complete grids of 0.25 ha each with incomplete grids towards the periphery.

Each grid is uniquely numbered with the help of a unique grid line alphabets (A, B, C, D, E, F, G, H etc.) and a unique base line number on either sides (L3, L2, L1, R1, R2, R3, etc.). Hence a grid post having the marking as FL8 would be on F grid line and L8 base line (left side) (Fig 2). The assumption in this model is that the plants were planted with a uniform spatial density. The total plants planted within a grid are obtained using the formula – (Total plants planted/Total afforested area) X 0.25 ha . The total plants planted in the afforested site will be obtained from the plantation journal. Each grid is numbered and 10% of the total grids will be randomly selected.

Each grid (sample plot) will be located on the ground. The boundary corners will be clearly marked with raised earthen/rocks mound topped with a painted peg/stick and geo-location will be recorded. Within each of these grids, total enumeration of all the plants is carried out for survival, while height and girth are measured of every 5th plant. The graph of cumulative survival % versus area is simultaneously plotted and in case the accumulation curve after 10% sampling saturates (+2%) we will stop, else more grids will need to be sampled to account for the larger intra plantation variation till the curve saturates (+2%). At the time of field enumeration, the field staff of respective divisions are present and put their initials on the data sheets as the sign of authentication.

Drones will be used to capture images of plantation growth and survival in sites that cannot be accessed by foot or vehicle. These images will be cross verified with plantation records for assessment.

Data collection (objective wise)

Objective 1. Verification of the physical progress quantitatively and qualitatively

To verify the physical parameters outlined in Table 2, on-site assessments will be made to collect the data. The detailed collection method and evaluation parameters given in the following table.

Table 2. Data collection method and evaluation parameters

Items	Data collection methods	Evaluation parameters
a. Compensatory afforestation and other mandatory plantations such as CAT, NPV, ANR, etc.		
Species composition	Field observation and measurements	Year-wise data recording on: • Number of seedlings planted • Composition in terms of indigenous species, fruit species and NTFP species
Growth and survival	Field observation and measurements	• Survival percentage • Measurement of growth of planted species in terms of height and collar girth
b. Nursery raising		
Nursery activities	Nursery observation and stock verification	• Area under nursery • Species raised • Source of material • Irrigation • Polybags/ naked roots, composting pits, etc.
c. Weed Removal		
Lantana removal	Field observation	• Type of weed removed, • Technique adapted, intensity and extant of weed eradicated or removed.
Soil and moisture conservation measures	Field observation for quantitative check	• Number and size of check dams, percolation pits, drainage trenches, rock fill dams etc. • Physical quality of the structures • Perceptions of stakeholders on the effectiveness of soil and moisture conservation.
d. Linear activities		
Erecting of trenches, fencing and walls	Field observation	• Size of the structure • Suitability, effectiveness and present condition of the structure
Rejuvenation of river works	Type of the work and suitability	• Current status of the work • Extent of work and record of major works undertaken for rejuvenation of the river
e. Forest protection activities		

Items	Data collection methods	Evaluation parameters
Incidence of threats	Field observations Key informant interview Small group discussions with the local community	• Fire, grazing, illicit felling, etc. • Year-wise fire incidences • No. of fire lines created, fencing and trenches created • Other control measures done
f. Biodiversity and wildlife management, human-wildlife conflict reduction, construction of water holes and strengthening of infrastructure		
Biodiversity and wildlife management	Field observation	• Record of fodder species • Gap plantation of fruit-bearing plants (species and number) • Corridor protection • Fencing (running length), solar fencing and protection wall • Trenches • Watch towers • Details of awareness camps • No. and capacity of water holes • No. of camera traps and other equipment for wildlife protection
g. Works under catchment area treatment (CAT)		
Flow and Discharge Sedimentation and Erosion	Collection of data from the line departments such as watershed, hydrology, etc. Visual observation in the field and feedback from the local communities, landowners, and other stakeholders Focus group discussion and key informants' interview	• Perceptions of the effectiveness of CAT and its impact
h. Infrastructure development		
Forest-related infrastructure development such as Chowki/Range office, patrolling shelters, etc.	Visual verification of constructions/ renovation of roads, quarters etc.	• Extent of work completed • Number of structures constructed • Use and suitability • Target and achievement
i. Any other works undertaken in CAMPA fund		

Items	Data collection methods	Evaluation parameters
Official record-keeping	Verification of official records (non-financial) e-green watch portal	• Official upkeep of records • Data on e-green watch portal
Tagging of the location of the sites	Collection of real time pictures/maps Photos/ Google Earth images	• Records of location of compensatory afforestation areas, • General description of the afforested sites with GPS coordinates and maps

Objective 2) Process evaluation, impact and output evaluation including social, environmental and other impacts

Detailed interactions involving forest officials, villagers, workers, village heads, etc., to evaluate the process and to assess the impact of CAMPA will be conducted. Forest officials will be interviewed regarding site location, species selection and expected impacts from the plantation. A questionnaire-based survey will be carried out (Table 3), comprising detailed inquiries about employment generation, livelihood improvements, community participation, etc. Key points raised by stakeholders during discussions such as FGDs, KIIs, expert consultations, etc., will be recorded to throw light on the merits and loopholes in the implementation process.

Given the young age of plantations, it might be too early to estimate the biophysical impacts such as biodiversity enhancement, carbon sequestration and soil and water quality conservation. For a broad understanding of the biophysical impacts, paired site comparison where a nearby similar site without plantations/ other CAMPA interventions is compared with the plantation site will be undertaken. Parameters such as the presence of weeds and other disturbances, vegetation species composition, soil and water quality etc. could be compared using this approach to bring out the impact created by CAMPA activities. Also, based on the data on species planted and the field measurements (height, gbh of plants etc.) recorded, and using data from secondary literature, attempts will be made to assess the biomass production and carbon storage in the plantations.

Table 3. Data collection methods for process and impact evaluation of plantations of CAMPA

Method	Description	Parameters
Direct field observation	Observation in the field site and using basic tools like GPS, camera etc for quantitative enumeration and paired site wise comparison	• Biophysical impacts of CAMPA planation in terms of biodiversity, soil and water quality etc
Focus Group	A small group (6-8 people) will be	• Difficulties and gap

Discussions with local community using semi-structured questionnaires	interviewed together on a limited set of topics to explore in-depth stakeholder opinions and perceptions of the initiative and its impact. Using semi-structured questionnaires will ensure a standardized approach to obtain information from the group concerning the inputs, outputs and contextual factors of the initiative	areas in implementation • Suggestions to improve effectiveness of the plantations • Socio-economic impact of the plantation and involvement of the local community
Key informant interviews	Qualitative in-depth interviews with those who have first- hand knowledge of the initiative operations and context. These will provide particular knowledge and understanding of problems and recommend solutions	• Assess the difficulties and pitfalls • Case studies and gap areas in relevance and implementation • Best practices on how the effectiveness of the plantations can be enhanced
Expert interviews	Officials with experience of managing CAMPA projects to provide input on technical or other topics covered by the evaluation	• Assess the difficulties and gap areas in planning, monitoring and implementation • Best practices on how the effectiveness of the plantations can be enhanced
Photos/images	Good resolution photos to document the process and outputs along with google earth images of before and after	• Assess the extent of the plantation using google earth images • Document the evaluation process, stakeholders involved along with the outputs achieved

Objective 3. Cost-benefit analysis of the activities carried out under CAMPA projects

To enhance the efficiency of any project, it is important to choose means which will produce the desired output with the least resources. Plantations must be financially sustainable and economically viable. A cost benefit analysis will help to gauge the efficiency of the plantation process using indicators such as Net Present Value (NPV), Internal Rate of Return (IRR) and benefit-cost ratio (BCR).

The Net Present Value (NPV) of plantation indicates the current value of all cash inflows and outflows associated with the project.

$$NPV=\sum^{T} \frac{R_t}{t=0\ (1+R)^t}$$

R_t=net cash flow at time
t i=discount rate
t=time of the cash flow.

The profitability of the plantation activity will typically consider the time value of money and discounting future cash flows back to their present value. If the NPV is positive, it indicates the plantation project is expected to generate more value than the initial investment and is considered financially viable. If the NPV is negative, it suggests the plantation might not be financially viable.

Internal Rate of Return (IRR): The IRR is the discount rate will make the present value of the cash inflows equal to the initial investment. It indicates the percentage return expected from the plantations. If the IRR is higher than the cost of capital or the investor's required rate of return, the plantation is typically considered to be economically feasible.

Cost Benefit Ratio (CBR): This will be used to determine the relationship between the present value of benefits arisen from the plantations and the present value of costs incurred for establishing of the plantation.

$$CBR = \frac{PV\ of\ Benefits}{PV\ of\ Costs}$$

The CBR is used to assess the feasibility and desirability of a project or investment. If the CBR is greater than 1, it indicates that the plantation benefits exceed the costs, suggesting that the plantation is economically viable.

Annual cash inflows and outflows on account of tangible benefits and costs from various activities associated with the plantations will be determined. These may include monetary flows from plantations (site cleaning, pitting, irrigation, etc), nurseries (purchase of seeds/seedlings, vermicompost, maintenance, labor, etc.), income generation for local communities through employment, revenues and costs on account of infrastructure and other activities. However, as the plantations to be evaluated are likely in their juvenile stages, probably no income from the plantation in the form of food, fuel, and fodder production is being realized. Any production of fruits, fuel, fodder, etc. will be quantified and analyzed. Further, secondary literature on different species planted will be used to project the likely tangible benefits from the plantation over the rotation period and monetary values will be computed using market rates for these products for the evaluation of benefit over the cost.

Objective 4: Suggesting measures for improvement of plantations considering the feasibility and effectiveness

Upon discussion with the frontline staff, villagers and workers we will document specific challenges related to plantation practices and management on-site. This helps to analyze the factors that contribute to the success or failure of these plantations. Furthermore, successful practices that match local social and ecological contexts will be captured. Lastly, based on these insights, the project will offer division-specific recommendations to enhance the

effectiveness and impact of plantation practices.

I. Outputs and Deliverables

The comprehensive evaluation report to CAMPA will include:

- Details of sampling sites and sampling procedures applied
- Extensive results and discussions of the study including verification of physical progress, documentation of process and outputs, impacts and financial feasibility
- Detailed information on verification of reports, e-green watch, etc.
- Compiled stakeholder feedback report
- Best practices, pitfalls, and success stories
- Compiled plantation enumeration forms and summary forms
- Photographs and images of the plantation
- Drone shots at specific sites
- Geotagged photographs and plantation polygons on Google Earth
- Key points collected during stakeholder discussions like FGD and KII
- Photos of the sampling process and short video clips
- Detailed recommendations for the improvement of habitats and wildlife, forest protection, conservation measures, and the sustainable management of plantations.