Government of West Bengal
Directorate of Forests
Office of the Principal Chief Conservator of Forests & Chief Executive Officer,
West Bengal Compensatory Afforestation Fund Management and Planning Authority
(WB CAMPA)
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No. 936/CAMPA/2C-159(Vol-IV) Date: 12/02/2025

To: The Chief Executive Officer,
National Authority,
MoEF & CC, Govt. of India,
3rd Floor, Supreme Court Building,
New Delhi – 110001

Sub: Information on site specific details under CAMPA in respect of F.Y. 2018-19 to 2024-25.

Ref: Your Office letter no. 1) File No. NA-1/16/2023-NA dated 07/02/2025.
2) File No. NA-1/16/2023-NA dated 10/02/2025.

Sir,

With reference to the above mentioned subject, please find the enclosed herewith the required details of West Bengal State CAMPA as per prescribed format desired by you for your kind consideration and necessary action.

Encl: As stated above.

Yours faithfully,

12/02/25

Principal Chief Conservator of Forests
&
Chief Executive Officer, WB CAMPA

No. 937 /CAMPA/2C-159(Vol-IV) Date: 12/02/2025

Copy forwarded for information to:

1. The Principal Chief Conservator of Forests, HoFF, West Bengal.

12/02/25

Principal Chief Conservator of Forests
&
Chief Executive Officer, WB CAMPA

Monitoring Mechanism adopted by the States/UT as IIFM Bhopal

Monitoring Mechanism adopted by WB CAMPA as per methodology proposed by IIFM, Bhopal.

ANNEXURE-II

6. Sampling strategy

The following definitions have been used in this section:

Project area: The area of a plantation site

Project site: This is the location where the plantation was taken up

For direct field observation, a two stage sampling strategy needs to be adopted. Of the total plantation projects taken up, first we need to select the projects to be sampled and secondly in the selected projects then take up field enumeration.

a) Selecting the projects to be sampled

The level of precision in estimating survival percentage of plants depends on deviation admissible from true value of survival percentage at 95% confidence interval. Once the precision level is set, the sample area required in estimating survival percentage will be determined for each project site. The sample area for monitoring each project site must be calculated on the basis of the estimated variance of survival percentage in each project site. To estimate the number of plots needed for monitoring at a given confidence level, one should

obtain an estimate of survival percentage variance for each project site. This can be determined by taking a sample of 15 to 20 plots in each of the project sites.

Example to calculate survival percentage and the variance of survival percentage:

The calculations here are given assuming 25-30 trees were planted in a 0.5 hec area, 16 samples were taken from a give project site.

Table 1:

Plot no.	Survived	Died	Total	Survival %
1	23	4	29	0.79
2	22	6	28	0.79
3	20	10	30	0.67
4	21	9	30	0.70
5	15	15	30	0.50
6	20	5	25	0.80
7	23	7	30	0.77
8	19	11	30	0.63
9	26	4	30	0.87
10	27	3	30	0.90
11	24	6	30	0.80
12	22	8	30	0.73
13	23	3	26	0.88
14	25	5	30	0.83
15	21	9	30	0.70
16	19	13	30	0.63
			Mean	**0.75**
			SD =	**0.11**

Repeat this process for each project site and estimate the variance of survival percentage for all the sites.

Case (1): The project area across the project sites is equal and variance of survival % is also equal:

If the project area is equal for each project site, the number of plots per site = ni = N/k

n_i = sample size for ith strata
N = Total planted area
K = number of strata

Normally, the project areas in the various locations are not equal, hence this case is practically not applicable

Case (2): The project area across the project sites is unequal but the variance of survival % is equal:

If the project area is different, the number of plots per strata are estimated by proportional allocation, i.e., proportional to strata size.

$n_i = (N_i/N)n$

N_i = area of plantation for each stratum

N = Total area of plantation

n= total number of sample plots

$$n = \frac{t^2 pq}{d^2}$$ ..... Equation (1)

(Sampling Techniques, W.G. Cochran, Third Edition,1977, page.76)

If d= 0.05, t at 95% confidence level = 2; p=0.5 q=0.5

$n = (4 \times 0.5 \times 0.5)/ 0.0025 = 400 = n_o$

If $n/N < 0.1$ no finite population correction (fpc) is needed. If $n/N > 1$, fpc needed. Assume total area planted is 3200ha, the sample area equal to

$$n \text{ (with fpc applied)} = \frac{n_o}{1+\frac{(n_o-1)}{N}} = 400/ (1+(400-1)/3200 = 356$$

Project site	Project Area (ha)	Sample area (ha)
A	1342	= (1342/8892)*356 = 0.1509 x 356 = 53.72 = 54
B	2450	= (2450/8892)*356 = 0.2755 x 356 = 98.08 = 98
C	2100	= (2100/8892)*356 = 0.2362 x 356 = 84.09 = 84
D	1650	= (1650/8892)*356 = 0.1856 x 356 = 66.07 = 66
E	1350	= (1350/8892)*356 = 0.1518 x 356 = 54.04 = 54
	Total=8892	Total sample area = 356 ha

Case (3): The project area per site is unequal and variance of survival % is also unequal:

In this case it is recommended that, for each site the sample area may be calculated based on the variance of the survival % with respect to that particular site using equation (1).

Step-A: Calculate the estimated mean survival percentage 'p' and standard deviation of 'p' for each project site separately as shown below:

Project site -A				
Plot.no.	Survived	Died	Total	% of survival
1	23	4	29	0.79
2	22	6	28	0.79
3	20	10	30	0.67
4	21	9	30	0.7
5	15	15	30	0.5
6	20	5	25	0.8
7	23	7	30	0.77
8	19	11	30	0.63
9	26	4	30	0.87
10	27	3	30	0.9
11	24	6	30	0.8
12	22	8	30	0.73
13	23	3	26	0.88
14	25	5	30	0.83
15	21	9	30	0.7
16	19	13	30	0.63
			mean=p=	0.75
			SD =	0.11

Project site - B				
Plot.no.	Survived	Died	Total	% of survival
1	14	14	28	0.50
2	12	15	27	0.44
3	11	10	21	0.52
4	12	16	28	0.43
5	13	14	27	0.48
6	14	13	27	0.52
7	11	16	27	0.41
8	13	15	28	0.46
9	14	12	26	0.54
10	11	15	26	0.42
11	12	16	28	0.43
12	13	17	30	0.43
13	12	15	27	0.44
14	10	14	24	0.42
15	12	16	28	0.43
16	12	15	27	0.44
			mean=p=	0.46
			SD =	0.042

Project site - C				
Plot.no.	Survived	Died	Total	% of Survival
1	8	15	23	0.22
2	10	15	25	0.20
3	9	14	23	0.22
4	10	15	25	0.20
5	7	15	22	0.23
6	11	15	26	0.19
7	9	15	24	0.21
8	8	16	24	0.21
9	9	16	25	0.20
10	9	14	23	0.22
11	8	14	22	0.23
12	9	15	24	0.21
13	7	19	26	0.19
			mean=p=	0.21
			SD =	0.01

Project site - D				
Plot.no.	Survived	Died	Total	% of survival
1	12	15	30	0.40
2	10	15	25	0.40
3	9	17	26	0.35
4	8	21	29	0.28
5	7	15	22	0.32
6	11	15	26	0.42
7	9	12	21	0.43
8	10	14	24	0.42
9	12	18	30	0.40
10	15	15	30	0.50
11	12	17	29	0.41
12	9	15	24	0.38
13	8	21	29	0.28
14	9	23	32	0.28
15	10	18	28	0.36
			mean=p=	0.37
			SD=	0.06

Step – B:

Based on the mean survival percentage for each project site obtained in Step – A, and using the equation (1), calculate the sample area for each project site as shown table below column (4).

Col-1	Col-2	Col-3	Col-4	Col-5	Col-6	Col-7	Col-8
project site	Total Area (ha)	survival % = p	Sample area $n = n_o = \frac{t^2 pq}{d^2}$	n/N	n(fpc) $= \frac{n_o}{1+((n_o-1)/N)}$	Sample size n (after fpc correction)	% of project site
A	1240	0.75	300	0.24	241.71	242	19.5
B	2350	0.46	397.44	0.16	340.07	340	14.5
C	1890	0.21	265.44	0.14	232.85	233	12.0
D	1475	0.37	372.96	0.25	297.84	298	20.0

Note:

1. q = 1-p
2. Since n/N for each project site is greater than 0.1, finite population correction (fpc) to be applied for the sample size calculated in column-4. After applying fpc the final sample size for each area is given in column-7.

   N = sample area; N = Total area at project site

   Sample size, n (with fpc applied) = $\frac{n_o}{1+\frac{(n_o-1)}{N}}$
3. t = t-table value at 95% confidence level = 2
4. d = margin of error = 0.05
5. n(fpc) = sample size after doing final population correction

Case (4): If the survival percentage for different plantation sites is not available,

choose 10% of the plantation area for each site as its sample size.

b) Field enumeration in the selected projects

After studying the approaches adopted to sample multi-row block plantations by the various State Forest Departments, ICFRE and other research organizations it was felt that the row sampling approach with 10% sampling intensity would be the best tradeoff between accuracy and effort. This approach is easy to implement since the forest personnel are already attuned to this in their regular monitoring cycles. The field enumeration will cover assessment of two aspects of the plantations namely survival and growth followed by aggregation of the results:

- **Assessing the survival:** In multi-row block plantations, any row can be selected as initial or starting row for counting and then every 10th row should be selected. In these rows all the plants should be counted till the end of the row, either dead or surviving, for calculation of survival percentage. For example, if 2nd row has been chosen as initial or start row then subsequent rows selected should be 12th, 22nd and so on till the end of the plantation area. All the plants of every 10th row need to be enumerated. The field sampling strategy is provided for in Annexure-I.
- **Assessing the growth parameters:** Generally the health of a plantation in expressed in terms of growth parameters of the plants. For this we measure the plant height and plant girth. This should be done at 1% sampling. Therefore, in all the rows selected above for

survival, one start plant should be selected for height and girth measurement at collar (50 cm above the ground level for upto 3 year old plantation and 100cm above ground level for upto 5 year old plantation and for plantations older than 5 years, diameter at breast height should be taken). Thereafter, every 10th plant should be selected for further recording of height and girth. If the start plant in row one is 3rd then other plants to be measured will be 13th, 23rd, 33rd and so on. It is advised to change the start plant for growth measurement in the 12th row by using a random number between 1 to 10. If the start plant in this 11th row comes to 5th then other plants to be measured will be 15th, 25th, 35th and so on. This should be followed for all the rows. The field sampling strategy is provided for in Annexure-I and the format for collection of enumeration data is provided for in Annexure-II. The survival percentage of the plantation can be calculated as the percentage of surviving plants compared to the total plants enumerated. The growth parameters of the plantation namely plantation height and plantation girth can be averaged from the total plants for which these two parameters were measured. These plantation level indicators then need to be filled in the Plantation Field Summary Report provided for in Annexure-III.

- **Aggregating the findings** : For the purpose of reporting, the survival percent should be weighted by net area planted in the same model. The percentage should be reported separately for each plantation model covered for the counting. i.e. if the survival percentage for irrigated teak plantation model has to be calculated, we need to first measure the survival percentage of the sample projects. i.e. if this comes to 60% for a 40 ha irrigated teak plantation, 40% for a 100 ha irrigated teak plantation and 80% for a 20 ha irrigated teak plantation then the weighted mean by net area planted comes to (60X40 + 40x100 + 80x20)/(40+100+20) which comes to 50%. So the overall survival percentage of the irrigated teak plantation model is 50%.