EP No: 13/2022-23 CONSERVATION, IMPROVEMENT, SUSTAINABLE UTILIZATION, AND INTEGRATION OF RESIN-YIELDING TREES OF *BOSWELLIA SERRATA* IN AGROFORESTRY

INTRODUCTION

The *Boswellia serrata* species is an integral part of the Terminalia-Combretum woodlands. However, these ecosystems are under severe threat due to anthropogenic pressures, leading to habitat fragmentation, degradation, and conversion to agricultural and pastoral lands. These activities have caused a significant decline in *Boswellia serrata* populations, with many areas reporting a lack of seedlings and natural regeneration. This species is renowned for producing frankincense, a resin that has been traded since ancient times for its applications in food, cosmetics, and perfumes.

Vegetative or clonal propagation in tree breeding programmes has been emerging as a strong attraction to the traditional seed orchard breeding system.The use of clonal propagation is rapidly increasing and is of vital importance to any tree improvement programme There has been growing interest in using the techniques of clonal forestry and thereby exploiting the considerable amount of genetic variability existing in the natural populations and partly because of tremendous yield improvement by adopting the clonal forestry approaches (Leakey, 1987). However studies pertaining to clonal forestry are not available either for research reference or for commercial utility in *Boswellia serrata* and hence demand research in this front.

Despite its economic importance, *Boswellia serrata* suffers from low regeneration rates, loss of genetic diversity, and threats from overharvesting and deforestation. This project focuses on conservation strategies, genetic improvement, and agroforestry integration to ensure the species' sustainability and promote rural economic development.

OBJECTIVES

1. Identify and conserve superior genetic resources of *Boswellia serrata*.
2. Conduct progeny evaluation and genetic analysis to estimate variability and heritability.
3. Develop strategies for integrating *Boswellia serrata* in agroforestry systems.
4. Create protocols for macro clonal propagation to enhance productivity.
5. Analyze the economic viability of various agroforestry models.
6. Engage rural communities for sustainable utilization and conservation of non-timber forest products (NTFPs).

MATERIALS AND METHODS

Populations of *Boswellia serrata* growing areas in Tamil Nadu were identified and A total of 40 CPTs were selected based on morphological traits such as height, girth at breast height (GBH).Seeds were collected from the selected CPTs during the May-June fruiting season.Seeds were sown in raised nursery beds.Poly bags (16x30 cm) were filled with a mixture of red earth, sand, and Farmyard Manure (FYM) in a 1:1:1 ratio. With additionally 30 g vermicasting15 g Vesicular-Arbuscular Mycorrhiza (VAM)6 g Azospirillum6 g Phosphobacteria per bag has been applied.Once seedlings reached a height of 15 cm, they were transplanted into poly bags and totally 440 seedlings of *Boswellia serrata (including 10% casualties)* has been established and medicinal crops and horticultural crops purchased from certified nurseries.

A 1-hectare experimental plot at Melchengam Research Centre was divided into four subplots.Each subplot (0.25 ha) incorporated *Boswellia serrata* with various horticultural and medicinal crops.A control plot was established with *Boswellia serrata* alone.Soil testing has been done initially. *Bosewellia serrata* plants have been planted at an Espacementof 5m x 5, horti intercrop at 4m x 5m and medicinal crop planted at 1.5 m x1.5m.The pit size is 45 $cm^3$and each pit was filled with inputs such as FYM, tank silt and microbial cultures (Azospirillum and Phosphobacteria) as per the write-up. Each subplot 100 numbers of Boswellia serrata seedlings have been planted and species and number of Horticultural intercrops & medicinal intercrops as detailed below.

Table 1 -Crop Combinations and Spacing:

Area	**1 ha.**
Spacing	5m x 5m (for tree crop)
No. of trees planted	400 trees / ha.
Size of the pit	45 cm^3 for tree crop
Size of the pit	30 cm^3 for intercrop
Spacing	4m x 5m (for Horti inter crop)
Spacing	1.5m x 1.5m (for medicinal crop)

Phenotype Identification

Nursery establishment

Preparation of planting site

Experimental plot – 1st year

Table 2 - Details of sub-plots:

Sub Plot Name	Horticulture crop (125 no's each)	Intercrop (625 no's each)
Sub Plot 1	*Phyllanthus indofischeri*	*Coleus aromaticus*
Sub Plot 2	*Emblica officinalis*	*Aloe vera*
Sub Plot 3	*Phyllanthus acidus*	*Cymbopogon citratus*
Sub Plot 4	*Citrus limon*	*Decalepis hamiltonii*

Observation to Be Recorded:

1. Soil test will be done before planting and at the end if the experiment.
2. Initial height of the plants will be recorded.
3. Initial collar girth of the plants will be recorded.
4. Annual height will be recorded up to 5 years.
5. Survival percentage will be recorded with respect to various Treatments.
6. Phonological character will be recorded.
7. Meteorological data will be recorded.
8. The seeds collected from respective tree will be recorded.
9. Harvest from each crop raised will be recorded.

Table 3 - MeasurementData 2023(Initial):

Sl. No.	Treatment	planted	Survival		Avg. height
		(No.)	(No.)	%	(m)
1.	Sub plot -1	100	100	100 %	0.29
2.	Sub plot -2	100	100	100 %	0.28
3.	Sub plot -3	100	100	100 %	0.28
4.	Sub plot -4	100	100	100 %	0.29
	Total	**400**	**400**	**100%**	

Table 4 - Measurement Data March 2024:

Sl. No.	Treatment	planted	Survival		Avg. height
		(No.)	(No.)	(%)	(m)
1.	Sub plot -1	100	100	100 %	0.29
2.	Sub plot -2	100	100	100 %	0.28
3.	Sub plot -3	100	100	100 %	0.28
4.	Sub plot -4	100	100	100 %	0.29
	Total	**400**	**400**	**100%**	

FINDINGS / INTERIM FINDINGS

1. Horticulture crops showed better survival and growth compared to medicinal crops in agro forestry systems.
2. **Subplot 1:** Survival percentage of *Boswellia serrata* (72%), *Phyllanthus indofischeri* (91.2%), *Coleus aromaticus*(8.8%).
3. **Subplot 2:** Survival percentage of*Boswellia serrata* (42%), *Emblica officinalis* (92%), *Aloe vera* (20%).
4. **Subplot 3:** Survival percentage of*Boswellia serrata* (30%), *Phyllanthus acidus* (77.6%), *Cymbopogon citratus*(25.6%).
5. **Subplot 4:** Survival percentage of*Boswellia serrata* (73.6%), *Citrus limon* (70.4%), *Decalepishamiltonii* (0%).
6. *Boswellia serrata* performed better with *Phyllanthus indofischeri* and *Coleus aromaticus* (72% survival).(sub plot one)
7. Medicinal crop *Decalepis hamiltonii* showed poor adaptability (0% survival).
8. Total survival percentage of experiment plot
    i. *Boswellia serrata*: 40.5% (160 Plants)
    ii. Horticulture crops: 82.8%
    iii. Medicinal crops: 13.6%
9. Horticulture crops perform better under *Boswellia serrata*-based systems compared to medicinal crops.
10. The experiment is ongoing.