Project – eDESIGN

(Designing Eucalypts for Sustainable Improvement and Gain)

Team Name	**: Project - eDESIGN**
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Unit	**Corporate R&D**
Location	**Bangalore**
Date of Commencement	**30 AUG 2009**
Date of Implementation	**On going**

Please refer the synopsis and project brief in the enclosed documents

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Synopsis

A new subline breeding scheme is devised to develop elite "designer eucalypts", packaged with genes controlling pulp yield, and adaptable to four major agro climatic regions on a sustained basis for ITC. A central grafted hybridisation archive, derived from nucleus populations in four sublines developed by introducing and testing natural germplasm of *Eucalyptus camaldulensis* and *E. urophylla,* will generate elite trees at a predictable rate. Intensive marker assisted breeding will be undertaken in the archive to produce designer trees with high pulp yield on a sustained basis for redeployment to the respective agro climatic sites.

Introduction

"A game changing breeding strategy of designer trees will keep ITC well ahead of its competitors..."

ITC is a leader in *Eucalyptus* farming in India and its clones are hugely popular in the country. However, compared to other countries, we are still in the early rungs of the tree improvement ladder and it is vital to move to higher horizons if we are to make quantum leaps in the traits of interest. It is essential to build an assembly line that will give cumulative improvement with time and develop genetically diverse clones for sustained release to farmers. **Designer trees are composite varieties with the right combination of genes and best traits, developed using sophisticated molecular breeding tools**. The proposed strategy aims to formulate a game changing breeding plan and capability for ITC that will keep it well ahead of its competitors and continuously breed new *Eucalyptus* varieties designed to meet the company's requirements.

Need for broad genetic and trait diversity

Genetic diversity is the raw material for genetic gain, essential to improve traits of interest to PSPD, like Pulp yield and lignin content in *Eucalyptus* that is crucial for enhancing profitability of paper business. The current *Eucalyptus* clones are of a narrow genetic base which limits our options for quantum improvement in pulp yield and quality. It is important to infuse new genes from high pulp yielding species and domesticate them to the catchment areas of our paper mill. It is also a precaution against epidemics like the recent gall infestation, given the scenario of a few clones planted repeatedly over large areas.

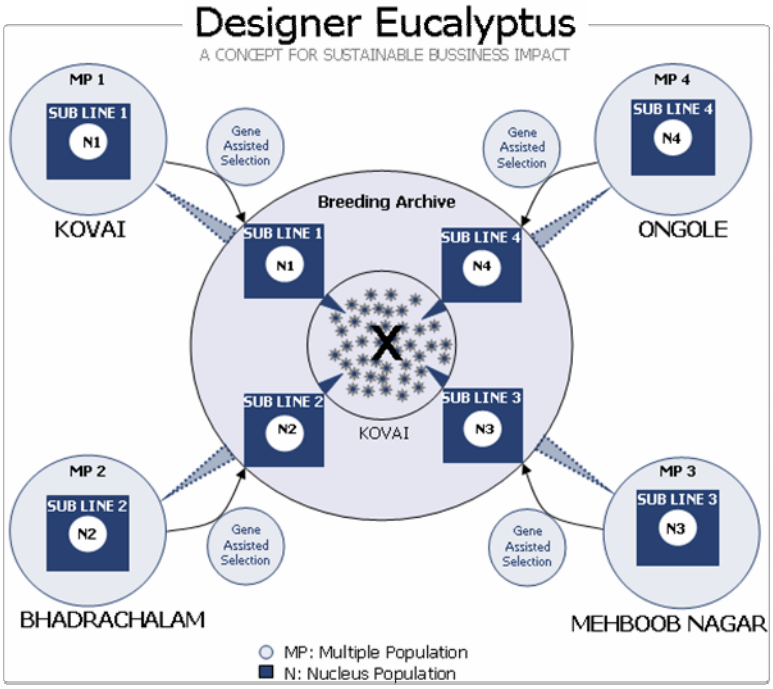
Domestication of Eucalyptus for sustained productivity

E. camaldulensis, the species of our choice, is quite adaptable to the hot dry conditions in peninsular India but it is quite inferior in pulp yield compared to other species like *E. urophylla* and *E. grandis* used in countries like Brazil. ITC did well to tap early benefit from *E. camaldulensis* by cloning superior trees and reducing harvest age to four years, moving horizontally to profit PSPD business.

It is however necessary to tap the best of *E. camaldulensis* by screening the natural germplasm for trait diversity available in the species and domesticate them to our conditions. *E. urophylla*, which is native to Indonesia, is another species that is valued for its pulp and holds promise for enhancing pulp yield in our conditions. It is proposed to screen large populations of this species to infuse genes and ensure that trait diversity is not lost during the course of domestication.

Multiple Population Breeding Strategy

A new strategy has been initiated to develop sublines in *Eucalyptus camaldulensis* and *E. urophylla*. This innovative strategy involves germplasm introduction of wide genetic diversity (from at least 200 superior trees), from the respective natural geographical regions of the species, and testing in four diverse agro climatic regions. Four sublines would be constituted by selecting 100 outstanding trees suited to each region (400 in all) after screening for growth and pulp yield using hand-held NIR and molecular markers.



The trees in each subline will be cloned and grafted, for clone evaluation and deployment, and further breeding in a central archive, located at the field station in KOVAI unit of PSPD. This site is amenable for year round flowering with facilities for pollen storage and controlled hybridization. Cultar, a flower inducing hormone is used to obtain copious flowering in grafts. A crossing schedule is drawn up each year between nucleus populations of 10 elite trees in each subline. This strategy ensures production of new varieties each year. A hi-tech glass house is

used to facilitate good seed set and multiplication of seedlings for quick evaluation and deployment.

Marker assisted selection

Molecular markers will be used to screen the progeny emanating from crosses, for pulp yield and drought tolerance. Trees of both *Eucalyptus* species will be selected for crossing, based on specific combining ability, to ensure predictability in offspring for traits of interest. A nucleus of best combiners in each subline would be maintained for sustained production of new varieties each year. Advanced generation breeding lines will also be developed between crosses of outstanding individuals of each subline, to pyramid genes controlling pulp yield and adaptability, and produce designer *Eucalyptus* varieties to suit each location.

Benefits to ITC from the innovation

The new strategy will lay a strong platform for designing composite varieties of two important *Eucalyptus* species using the best trees with high genetic and trait diversity. The assembly line developed in the breeding archive will ensure sustained production of new recombinants each year. Vertical growth through marker assisted pyramiding of genes will enable quantum growth through production of outstanding recombinants in a regular manner. ITC will continue to lead the country in *Eucalyptus breeding*, as it holds the elite germplasm, and release varieties of known pedigree.