

Context

- **Surface of the forest area:** 43.000 ha of Eucalyptus afforestation after savannah near Pointe-Noire (Congo).
- **Soil properties:** sandy soils (90% of sand, less than 7% of clay); deep, acidity, very poor chemically, poor in Organic Matter (< 1% in the top soil), low CEC (Nzila, 2002).
- **Climate:** subequatorial with one pronounced dry season (4-5 months). Average annual rainfall = 1200 mm ; average annual temperature = 25°C (Bouillet et al., 2004).
- **Management:** Short rotation (7 to 8 years between plantation and harvesting), pulp wood production.
- **High variations in productivity across the forest area** despite an apparent homogeneity of soils: 5 m³/ha/year to 43 m³/ha/year, averaging to 15-20m³/ha/year for 7-year-old stands of the clone under study (PF1 1-41).
- **Comprehensive studies of biogeochemical cycles** demonstrated the importance for this area of:

- ✓ The organic matter (Nzila et al., 2002)
- ✓ The thickness of layer A1 (Bouillet et al., 1999)
- ✓ The site topography (Nzobadila, 2002)
- ✓ The fertilization regime Bouillet et al., (2004)

But only 50% of the productivity explained

Stand management disconnected from the site potentialities

Objectives

Identify the most relevant site factors that drive the production in this region
Provide to the forest manager, tools and indicators to estimate the wood production and carbon sequestration

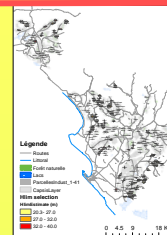


Figure 1: Map of eucalyptus plantations near Pointe-Noire (Congo)

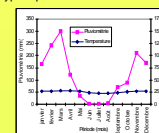
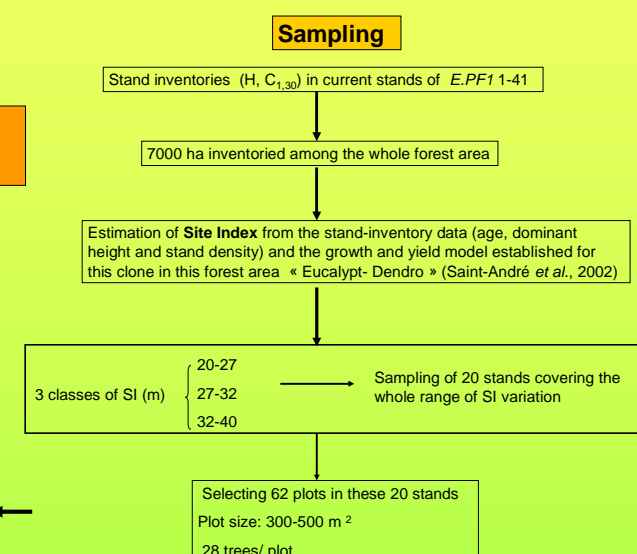
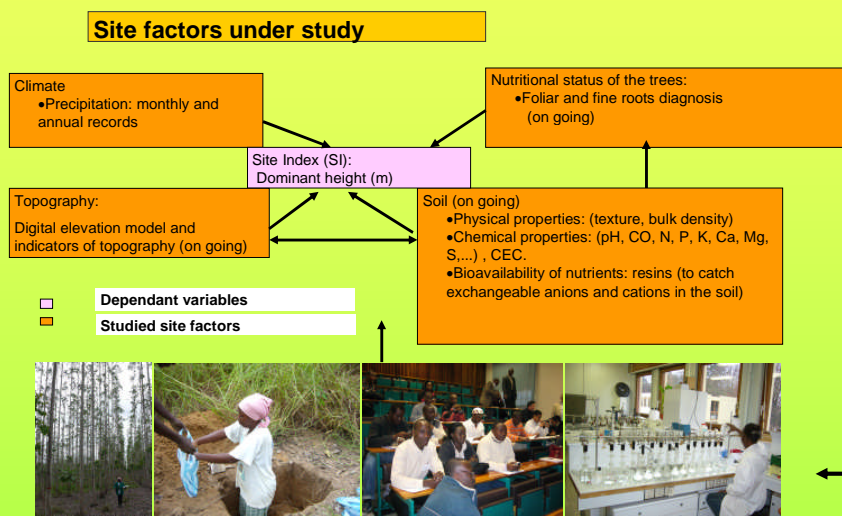


Figure 2: Temperature and Rainfall at Pointe-Noire (1992-2002)

Methodology



Preliminary Results

Plot characteristics

Variables	Average	minimum	maximum	Standard deviation
Age (years)	12	9	15	2
Dominant Height (m)	30	26	36	2
SI (m)	31	26	38	3

➤ Variations of SI: from 25,7 m to 37,7 m

Soil Chemical Properties

Depth (cm)	OM (%)	Total N (%0)	Phosphorus (mg/kg)	S(Ca,Mg,K,Na) (me/100g)	CEC (me/100g)
0-10	0.27-1.65	0.10-0.61	0.87-19	0.31-0.66	0.31-1.14
10-20	0.34-1.20	0.15-0.45	1.04-25	0.37-0.56	0.41-0.92
20-30	0.28-0.76	0.12-0.27	0.88-21	0.33-0.45	0.36-0.61

➤ There are the differences between sites, but only 16% of SI variations are explained by regression with the soil chemical properties.

Between and within stand variability of SI

- ANOVA using GLM procedure of SAS software
- “Stand” and “Plot within Stand” effects: R² = 0,79
- “Stand” effect only : R² = 0,62

Foliar and fine root chemical analyses

Variables	Average	Minimum	Maximum	Standard deviation
N (%)	1.51	1.12	2.08	0.21
	0.45*	0.31*	0.68*	0.08*
P(%)	0.13	0.09	0.20	0.13
	0.24*	0.05*	0.43*	0.11*
K(%)	0.50	0.38	0.60	0.05
	0.26*	0.13*	0.42*	0.07*

* = Roots contents

- no relationship with site index, except for foliar magnesium concentration: a weak negative correlation with SI (r²=0.23).

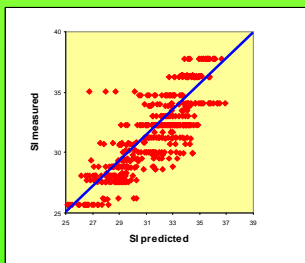


Figure 3: SI predicted by PLS regression versus Measured SI (in m)

Near Infrared Reflectance Spectrometry of soils (NIRS)

- NIRS measurements and PLS regression however confirm that organic matter (C and N), Ca, and Phosphorus are of importance for Site Index predictions.
- ✓ But there are probably other variables, not related to soil chemistry, which can be detected on the NIRS spectra and which take part in the SI variations.

Frequencies involved only in SI prediction

Frequencies involved in both SI and Soil Organic Matter predictions

Use of the VIP (Variable Importance for Projection), calculated for each frequency of the NIRS Spectra. A high VIP indicates that the frequency is of importance for the variable prediction

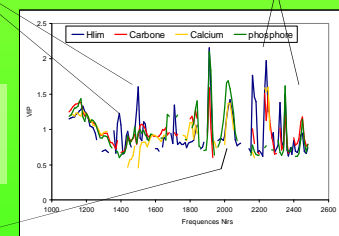


Figure 4: Variable Importance for Projection for SI and some Soil Chemical Properties

Frequency involved in both SI, Calcium and Phosphorus predictions

Preliminary Conclusion

- The chemical analyses of the leaves, roots and soils confirm the heterogeneity of the sampled plots.
- The variation of site index (SI) cannot be explained by solely foliar or root nutrient concentrations.
- In addition to the organic matter, there are others variables supporting the variability of Site Index which could be detected on the NIRS spectra and which would not be related to the classical soil chemical analyses.

Perspectives

- Pursue the statistical analyses by testing other methods (Analysis of Principal Components etc..).
- Pursue the collection of soil measurements (soil structure, test of ions exchange resins) and integrate these new measurements in the data analysis.
- Scientific papers and PhD report.

Literature

Bouillet J.P., Safou-Matondo R., Laclau J.P., Nzila J.D., Ranger J., Deleporte P., 2004 : Pour une production durable des Eucalyptus au Congo : La fertilisation. Bois et forêts des Tropiques n°279 (1), p 25-34
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