Estimation of fruit tree production by quantitative indicators: the case of lychee in Madagascar

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INTRODUCTION

Context

- Madagascar: **the first exporter of lychee** in the world - 25 000 t/year.
- **The quantity** of production available for the market **is still unknown** few weeks prior to the harvest to organize the campaign.

Difficulties for yield estimation

- Climatic variations.
- Differences in agricultural practices.
- Production distributed between 30,000 smallholders farmers with small areas located throughout the region.

Aim of the study

- Necessity to develop **simple tools at the tree level** in order to estimate the production.

MATERIALS AND METHODS

Lychee chinensis Sonn - Kwai Mee
12 to 60 years

2015: 30 trees 2016: 35 trees
Heterogeneity of size

Madagascar
Toamasina
18° 3'34.18"S 49°24'3.33"E

Estimation from:
Physical and fructification characteristics of the tree
Canopy image analysis

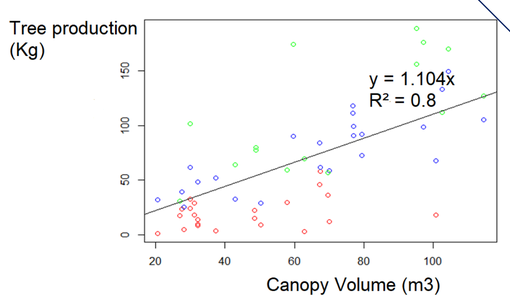
Analysis with R software – Linear regression

RESULTS

TREE PHYSICAL AND FRUCTIFICATION CHARACTERISTICS

Fruit load rate

Height



Charge rate =< 30 60 =< Charge rate < 30 Charge rate > 60

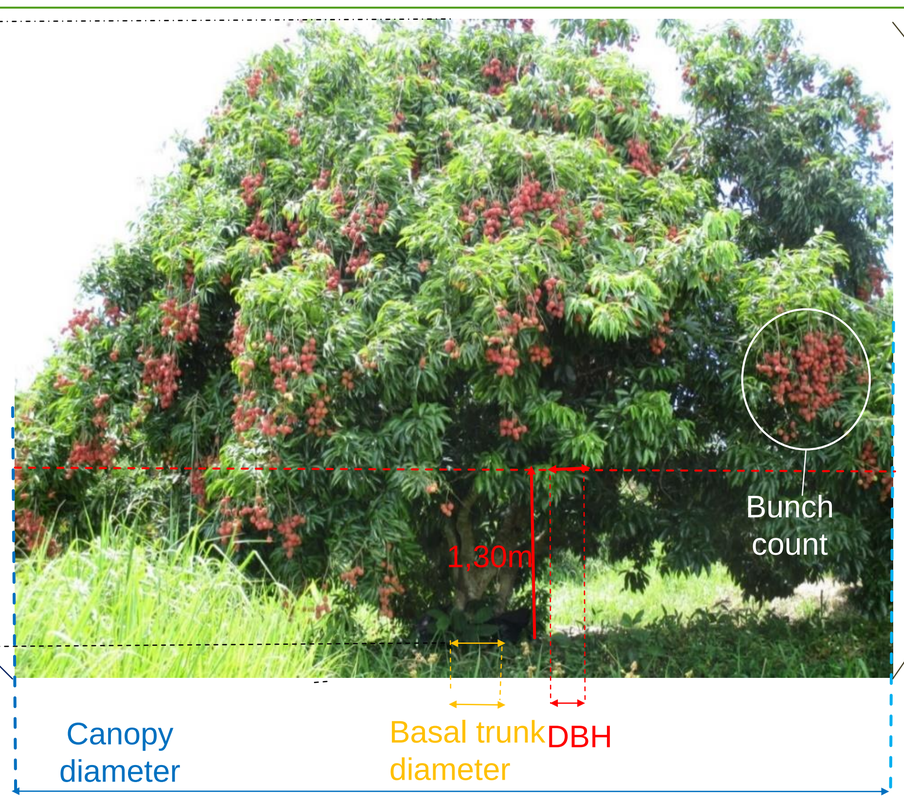


IMAGE ANALYSIS

Pictures of two opposed sides

Red pixels (Color of fruits)

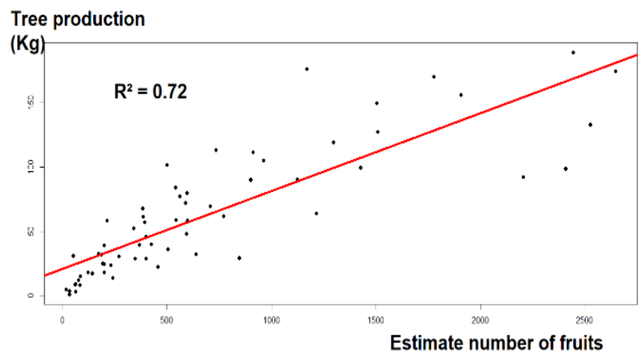
Estimate number of fruits

Tree production (1 – 859.8 Kg)	Canopy height (2.4 – 11.6 m)	Canopy diameter (3.9 – 14.1 m)	Canopy volume (20.6 – 1207 m3)	Basal trunk diameter (0.15 – 1.38m)	DBH (0.06 – 1.19m)	Estimated number of bunches	Real number of bunches (14 – 1170)
r^2	0.56	0.53	0.8	0.89	0.85	0.9	0.92
RMSE (Kg)	87.53	95.46	63.23	62.88	43.6	43.63	37.87
linear equation	y = 22.26x (1)	Y= 14.49x(4)	y = 0.57x(5)	y = 397.4x(2)	y = 650x(3)	y = 0.2664x (6)	y = 0.1878x (7)

Tree production depends on both i) tree size that represents a potential for production and ii) the flowering rate and the fruit load rate of the tree.

In order to achieve more accuracy, the load rate observed was used with the canopy volume in order to estimate the production.

	Canopy volume x load rate		Canopy volume (CV) + load rate (LR)	
Tree production	n= 65	n=64 (without the biggest tree)	n= 65	n=64
R^2	0.87	0.91	0.84	0.9
RMSE (n=65)	51.55	121.8	45.37	56.92
RMSE (n=64)	49.51	27.58	37.29	28.84
The linear equation	1.21x (8)	y = 2.23x (9)	0.48CV +1.02LR (10)	0.32CV +1.14LR (11)



CONCLUSION

Structure variables
- particularly effective when completed with a fruit load rate estimation
- Subjective estimations of the load rate

Bunch count
- increase accuracy
- time consuming

Image analysis
- most convenient tool
- allows faster estimation
- more objectivity

- The fruit production of a lychee tree could be estimated using **simple techniques.**
- Helpful to **forecast the available production** for the market for a better organization of the campaign.
- Supplementary information needed: the lychee tree distribution on plots over the production area (not yet been available in Madagascar).