

Trade-off analysis and economic valuation of intercropping teak – maize under different silvicultural management



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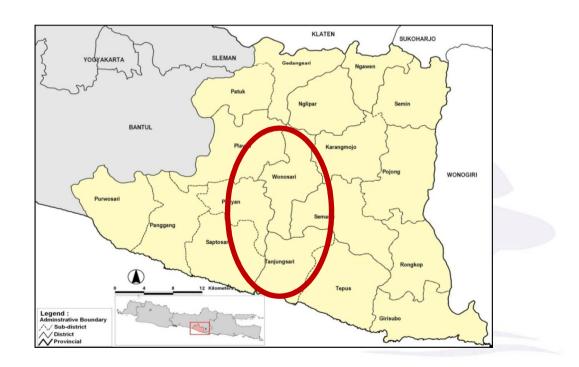


Research Location

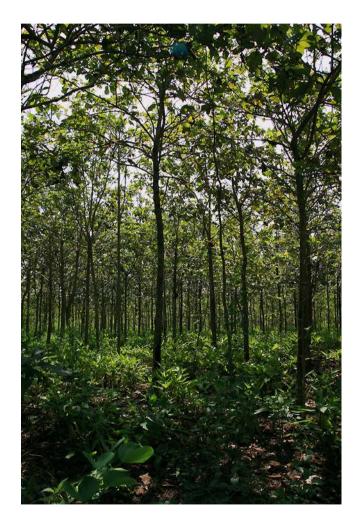
 Upland limestone in Wonosari, Gunung Kidul, Yogyakarta, Indonesia

Annual rainfall
1750 mm
Teak is the

dominant crop



Teak Cultivation and Issues



- Smallholder systems
- Lack of good tree management
- Low quality timber and hence low revenues for farmers
- Teak production in Indonesia increasingly comes from this smallholder systems

Challenges

- Can multiple combination of management practices (spacing, pruning and thinning) increase timber quality and revenues for smallholder systems?
- What are the trade-offs amongst different management practices?

Objectives

- To explore the effect of different management practices (spacing, thinning, pruning) on growth and production of teak and maize when they are intercropped,
- To identify the best and the most profitable management practices for smallholder teak.

Ex-ante analysis using the tree-crop interactions model WaNuLCAS

Profitability Analysis

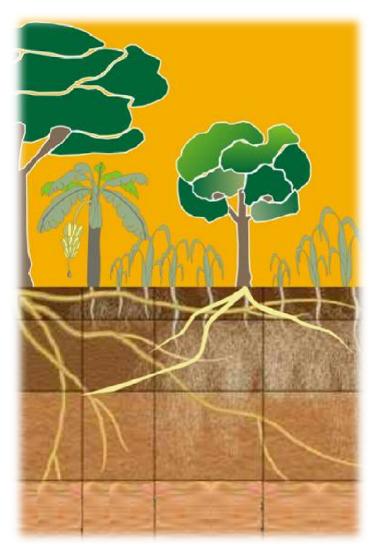


Ex-ante analysis using the tree-crop interactions model WaNuLCAS





WaNuLCAS model

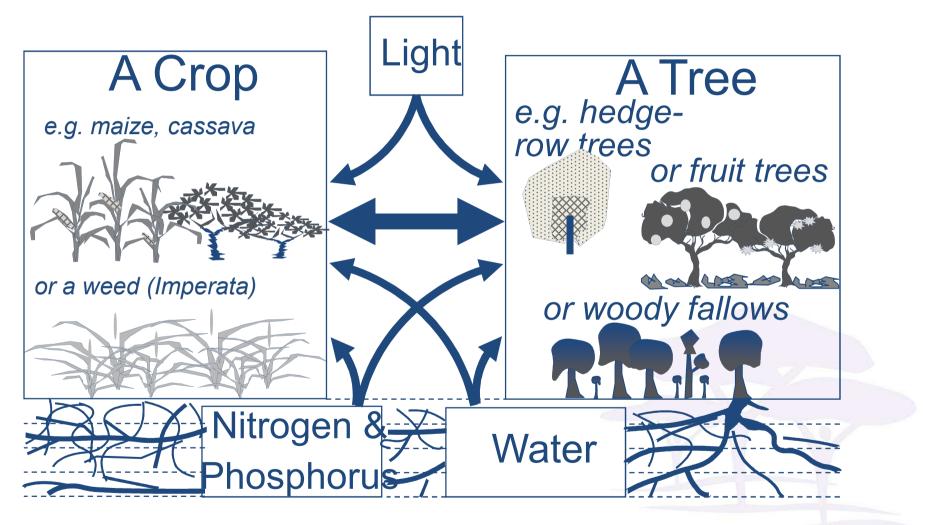


Was developed to represent treecrop interactions in a wide range of agroforestry systems where trees and crops overlap in space and/or time (simultaneous and sequential agroforestry).

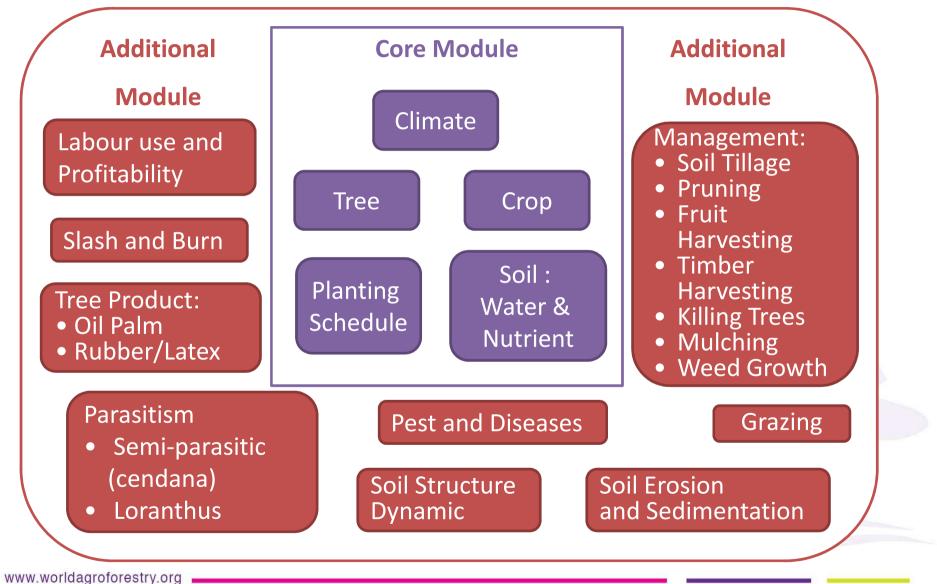
Spatial scale: plot (represents a four-layer soil profile, with four spatial zones.

Time scale: daily

Principle Component



Modules



🎋 STELLA® 7.0.3

File Edit Interface Run Help

WaNuLCAS3.2 S7 13JulyM2.STM 🖸 🖸 🖸 🚫 🗐 🖭 🖄 📼 👘 A -> -> A 🗂 🕅 🌄 🎽 -Welcome to the world of WaNuLCAS (version 4.0) A model of Water, Nutrient and Light Capture in Agroforestry Systems Disclaimer Clear graphs READ ME & tables Origin SAVE AS TO RUN & Model Update OUTPUT sector map since 3.1 SECTION SAVE HELP for Exit TO INPUT TO VIEW options SECTION MODEL UNITS Water parameters are expressed in mm (I.m-2): Nutrients in g.m-2; all Biomas Page Layout Formulas + 10 Navigating through modules Copy In map or model layer, 'Crtl G' is used to start navigate of certain variable that e Paste IFormat Painter

STELLA as model development platform: allows non-modellers

others modules either as input or output.

to easily run, diagramatically trace and modify the model

Dynamic linkage to Excel for input & output manipulation

Platform and Interface

Excel file with parameter libraries and specific settings for a given run

- 53

Conditional Format Cell Formatting * as Table * Styles *

Styles

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Welcome to the World of WaNuLCAS

A model of Water, Nutrient and Light Capture in Agroforestry Systems by Meine van Noordwijk, Betha Lusiana, Ni'matul Khasanah and Rachmat Mulia

M22

This Excel file contains inputs parameters that are linked to the WaNuLCAS model version 4.0, running in the STELLA 7 or beyond.

The 'AFSystem' sheet contains design of the system simulated. The 'Weather' sheet provides rainfall, evapotranspiration potential and temperature data. The 'Pedotransfer' sheet contains calculation tools to help generating tables of soll hydraulic properties needed in Zone 1...4. The 'Phosphorous' sheet contains a procedure to calculate Ka_P, P concertation and indices of P availability, such as P_Bray value. The 'Nitrogen' sheet contains initial soil nitrogen for each soil layer and zone, while the 'Slash and Burn' sheet contains tables for the impact of fire.

The 'Crop Management' and 'Tree Management' sheet determine type of crops and trees used in the simulation part of the calender of events that govern the simulation; other events are set within STELLA model itself. While, the 'Crop Library' and 'Tree Library' sheets allow you to choose from a (so far small) database of crops and tress to use in the simulation. The 'Profitability' sheet contains profitability input needed in the simulated systems.

IN ALL SHEETS, YOU CAN ONLY CHANGE VALUES IN BLUE FONT !!!



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low to link and what results can be obtained fror WaNuLCAS STELLA

Type Ctrl+U to update all crop & tree parameters and profitability Type Ctrl+Y to update all soil parameters Type Ctrl+W to update all weather parameters

Outputs and Inputs

Outputs:

- Water, carbon, nutrient (nitrogen and phosphorous), financial and soil balance
- Tree and crop growth and production

Inputs:

Climate, soil characteristic, tree and crop characteristic, and managements

Modeling Steps

- Parameterization (climate, soil, management, tree: *T. grandis* and crop: maize)
- Calibration and validation (tree growth: height and diameter, crop: maize yield)
- Model performance evaluation
- Scenario simulation of management practices

Scenarios

Teak + maize (two cropping season per year)

Initial teak density, trees ha⁻¹ (tree spacing, m):

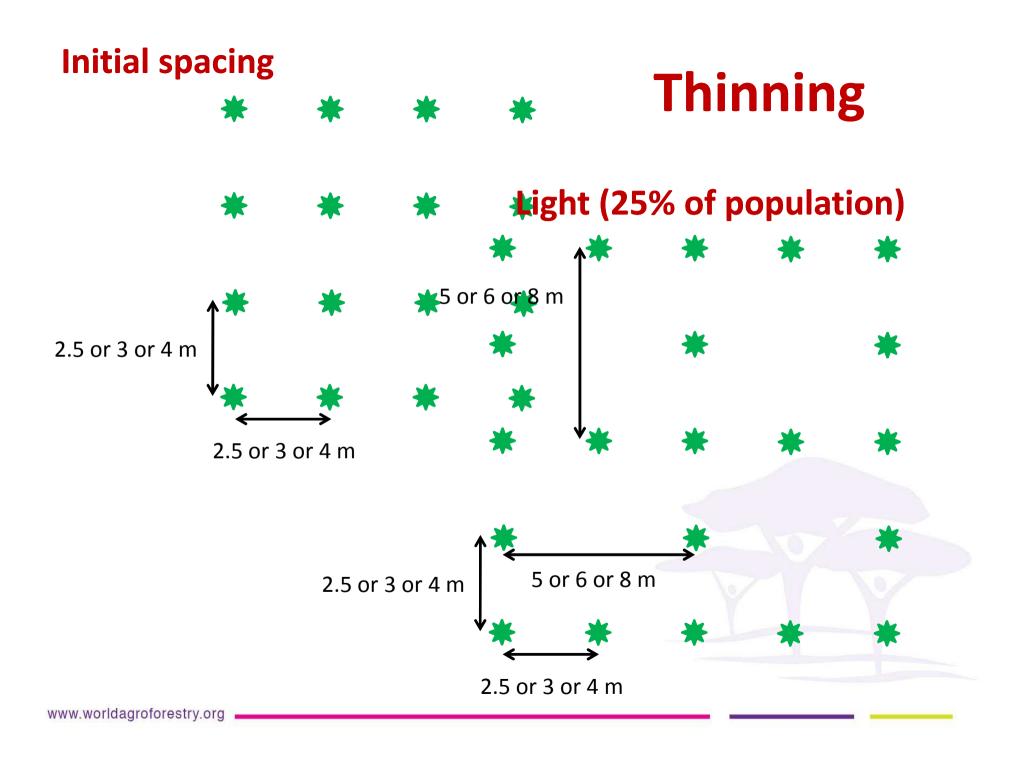
- 1600 (2.5 x 2.5)
- 1111 (3 x 3)
- 625 (4 x 3)

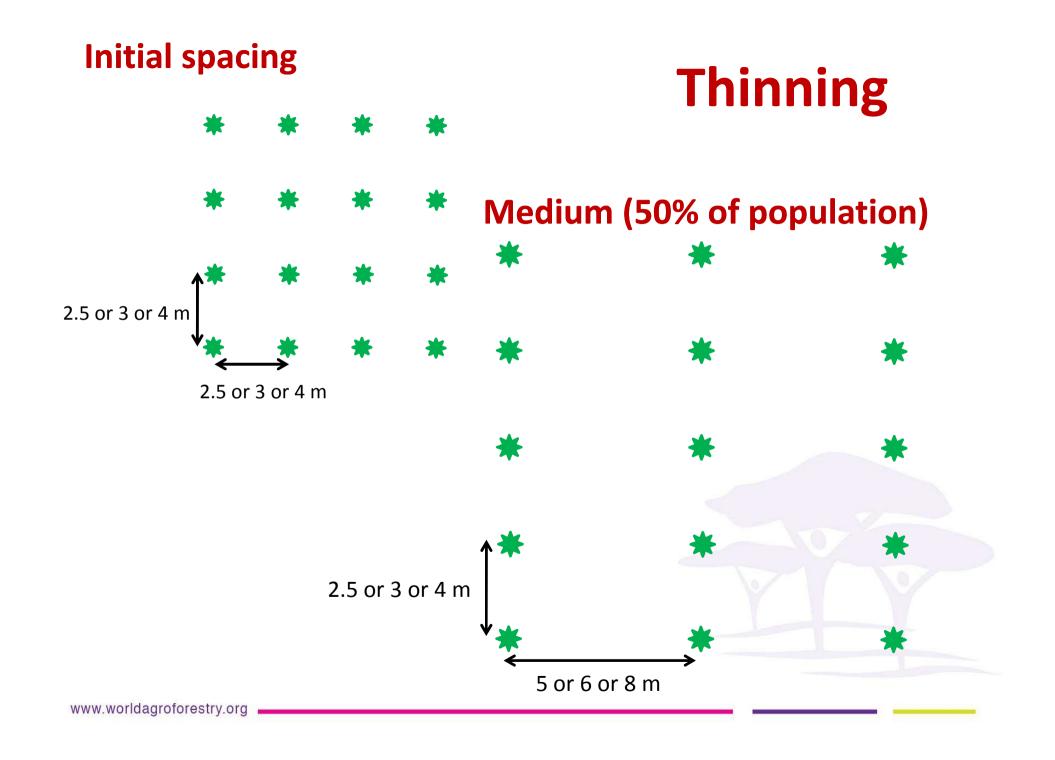
Thinning:

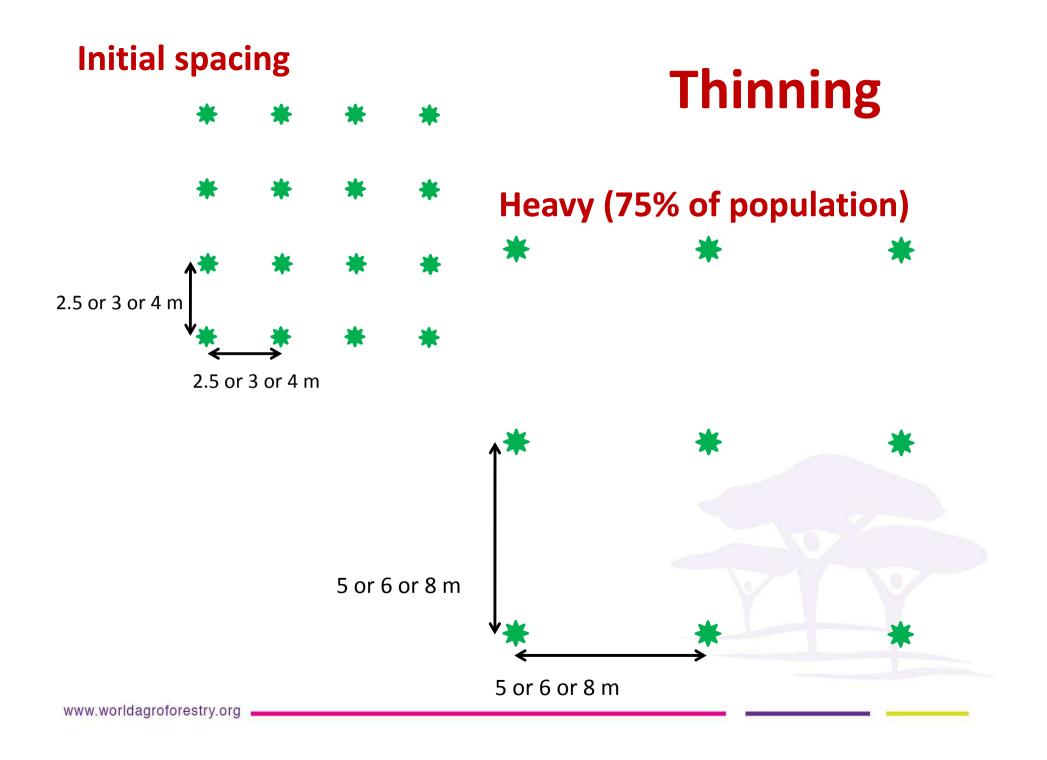
- Light :25% thinned at year 10
- Medium: 50%, 25% thinned at year 5 and 25% thinned at year 15 or 20
- Heavy: 75%, 50% thinned at year 5 and 25% thinned at year 15 or 20
- Pruning: 40% or 60% of canopy, pruned at year 4, 10 and 15

Maize monoculture: two cropping season per year

Teak monoculture: without pruning and thinning; allowing weeds to grow; with initial tree density 1200, 800, 400, 833, 556, 278, 469, 313, and 156 trees ha⁻¹

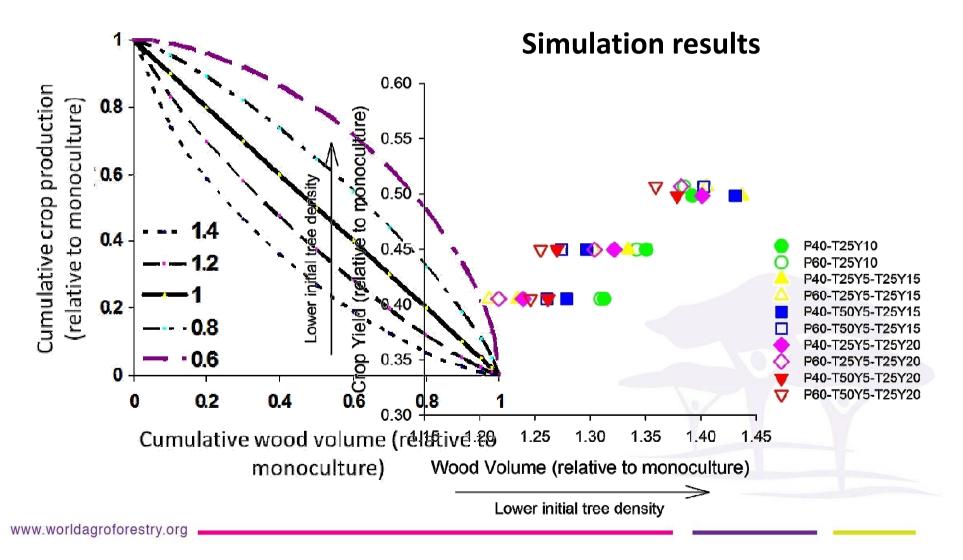


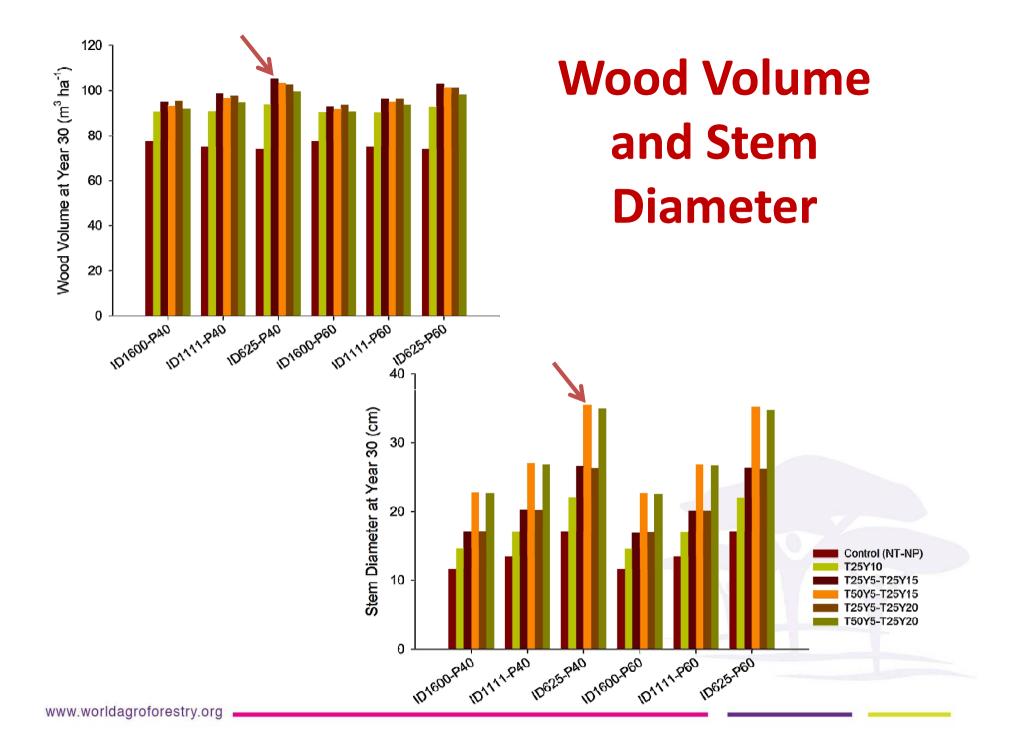




Trade-offs

Hypothesis







Profitability Analysis

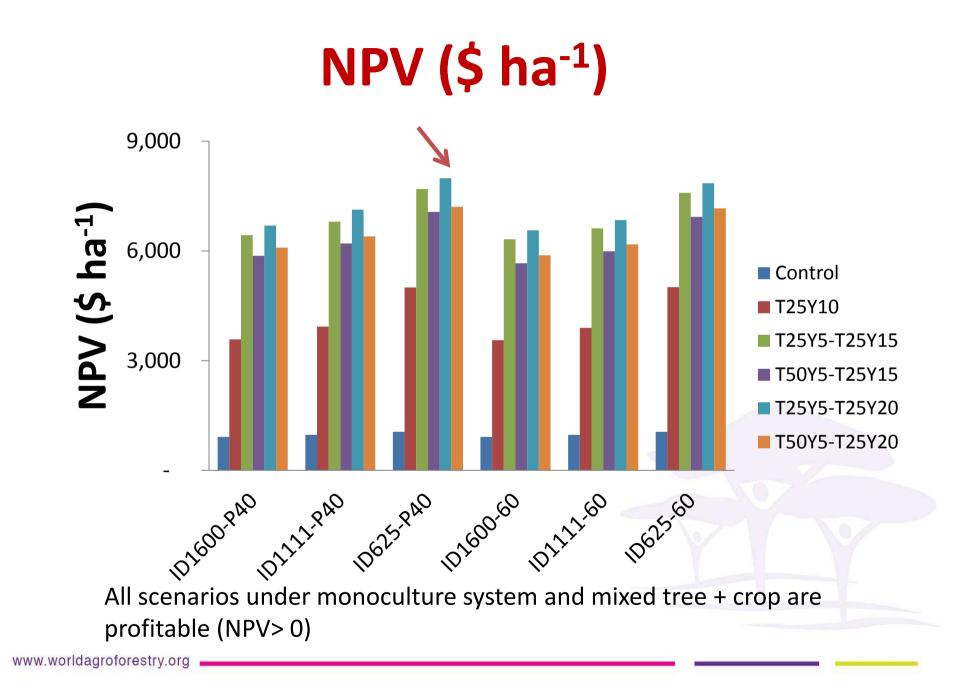




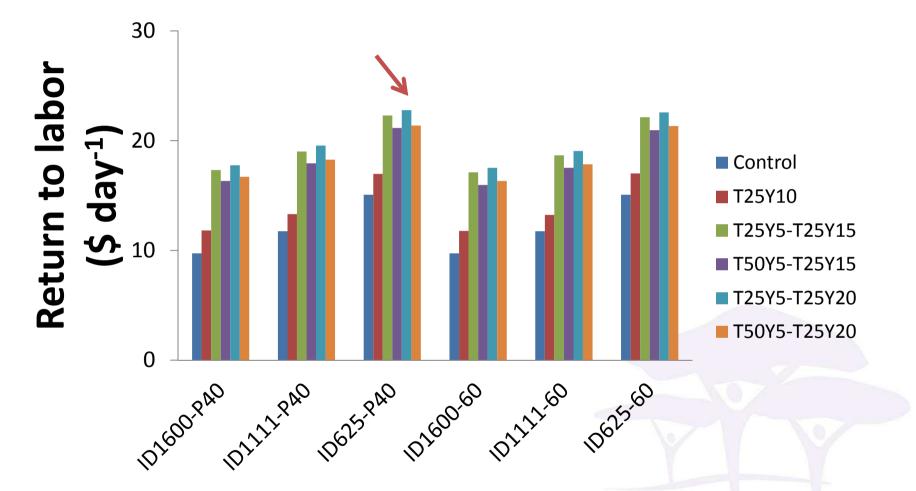
Assumptions

- Interest rate: 8%
- Wage rate: USD 2.75/day
- Teak price: USD 202 per m³ (2009 prices of Yogyakarta)





Return to labor (\$ day⁻¹)



All scenarios are above daily wage rate (more attractive for farmer to engage)

Conclusion

- Maize intercropping at the early stage of teak growth is clearly advantageous either at low or high teak population density
- Max. wood volume (m³ ha⁻¹) was provided by the system with initial tree density 625 trees ha⁻¹, 25% of it was thinned at year 5 and another 25% of it was thinned at year 15 and 40% of crown pruned at year 4, 10 and 15
- The highest NPV and return to labour was provided by the system with the second 25% thinning done in year 20 instead of year 15
- Lower costs at initial period is the key components for higher profitability



WaNuLCAS model and manual http://www.worldagroforestrycentre.org/af2/node/193



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