



Research project of counterparts funded at IPB

Name

Counterpart

Title

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B11

Oil palm agroforestry yield and financial estimation modeling

Background and Methods

The study was conducted at the B11 – Biodiversity enrichment experiment in oil palm plantations (EFForTS-BEE) of PT Humusindo, Jambi Province. To provide an illustration of the expected future yield and financial benefit of the biodiversity enrichment experiment, we applied system modeling, a method for estimating the future condition and situation based on the previous and current situation.

Results

There were 6354 trees of 6 species planted in the 48 plots of the experiment. About 3 years after planting (last measurement on September 2017), not all tree species were growing well. Only sungkai, petai and jengkol showed very good growth performance (survival rate, diameter and height). Their average diameter, height and production (timber volume or fruit production) were then estimated using the volume estimation formula: $V=1/4*\pi*D^2*T*f$ where $f=0.7$. The yield of sungkai, jengko and petai were simulated for 25 years (sungkai) and for 30 years (jengkol and petai) using the software program STELLA (figure 1).

Sungkai wood is categorized as fancy wood, because it has an attractive grain pattern. This wood is therefore usually used for furniture and interior design. Sungkai is usually harvested at 20-25 years old. Petai start bearing fruit at 5 7 years old and continue until they are 23-28 years old. When young they produce about 200-300 fruits but the number increases to 1000 1100 at 15 years old. The jengkol, petai and sungkai trees planted in the experimental plots are still young (about 3 years old). Nevertheless, some of the jengkol trees have already started fruiting. Jengkol starts to produce fruit at 4 5 years old and is able to continue producing until 25-30 years old. Mature jengkol trees are able to produce about 15-20 kg jengkol beans.

The size of tree islands or plots size or plot size affects the ecological and economic benefits of biodiversity enrichment plantings (Teuscher et al. 2016; Gerard et al. 2017). The bigger the tree island the higher the ecological and economic (in regard to oil palm yield) benefits. Based on these results, the model used in our research assumed an island size of 40x4m (1600m²), biodiversity levels of 1, 2, and 3 species, and planting distance 5x5m. It also assumed a smallholder oil palm plantation of about 3ha as the management unit. The biodiversity enrichment plot was simulated as being in the middle of the 3ha oil palm plantation. The financial benefit estimation was therefore based on 2.7ha oil palm and a 0.16ha tree island. At PT Humusindo the oil palms are planted in a 9x9m triangular grid, resulting in ~143 oil palms per hectare. The fresh fruit bunch (FFB) price received by farmers during the research period was IDR 1500/kg, the market price of jengkol and petai was IDR 5000/kg, and sungkai IDR 2,000,000/m³. Monoculture oil palm and oil palm agroforestry with different biodiversity enrichment levels was financially analyzed using feasibility criteria of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR). At an interest rate of 8%, time of 25 years and management unit of 3ha, monoculture oil palm is a very feasible investment with high NPV (IDR 162,685,167). But enrichment oil palm plantation with sungkai, jengkol and petai, not only with one species but also with 2 or 3 species (sungkai, jengkol, petai) give higher NPV, BCR, and IRR. Therefore, biodiversity enrichment of oil palm plantations using high economic value tree species in island plots of 1600m² at every 3ha oil palm plantation gives higher returns than monoculture oil palm. Enrichment thus provides economic as well as ecological benefits.

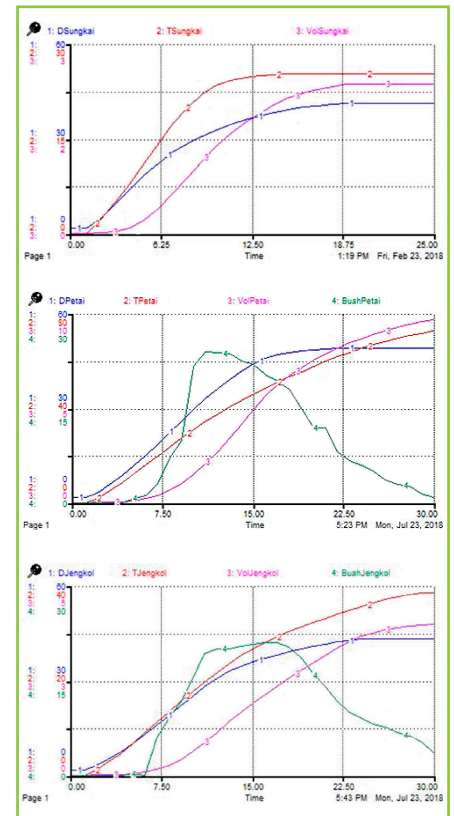


Figure 1. Estimation of the average diameter (cm), height (m) of sungkai (left), petai (middle) and jengkol (right) and volume (m³) of sungkai, fruit production (kg) of petai and jengkol planted in B11 plots. Blue line (-1-) is tree diameter, red line (-2-) is tree height, purple line (-3-) is tree volume and the green line (-4-) is fruit yield.