## Research project of counterparts funded at IPB

| Name | Counterpart | Title |
|---|---|---|
| **Suria Tarigan**<br>**Aiyen Tjoa**<br>**Nur Edy**<br>**Damayanti Buchori**<br>**Iskandar Z. Siregar** | **A07,**<br>**A05,**<br>**B07,**<br>**B09,**<br>**B14** | Oil palm landscape multifunctionality for biodiversity-based ecosystem functions |

### Background and Objectives

Agriculture intensification will continue to be the main choice in the future. Intensified land use in agriculture is irrefutably the main reason for biodiversity-based ecosystem service loss. In Indonesia, current area of agriculture land is approximately 40 million ha and 50% of it consists of monoculture plantation. Despite a general consensus that the only way to conserve species of high conservation value in the tropics is by land sparing and the provision of large forest reserves, there is some evidence showing that both multifunctional landscape and local complexity can have positive impacts on biodiversity in the oil palm habitat. At the oil palm landscape, conserving biodiversity and ecosystem processes can range from continuous adjacent forest remnant to tree patches (agroforestry) maintained within the oil palm landscape on steep slopes and riparian margins. The objective of this research was to analyze patches of tree planting inside monoculture oil palm plantation (agroforestry) as one variant of landscape multifunctionality for biodiversity-based ecosystem functions including soil macrofauna, soil water recharge/retention, pollinator, and nutrient retention. The specific objective of this study is to quantify relation between biodiversity parameters and ecosystem functions/services in oil palm multifunctional landscape.

### Methodology

Our study site is in the biodiversity enrichment experiment EFForTS-BEE (Teuscher *et al.*, 2016) located inside Humusindo oil palm plantation in Jambi Province, Sumatra, Indonesia. Oil palm trees were planted 6–12 years prior to establishment of the experiment. We sampled parameters related to soil fauna, soil porosity, soil infiltration, pollinators, understory

**Table 1.** Sampling locations

| Sampling location | Number of tree species | Plot number (size) |
|---|---|---|
| Agroforestry | 3 | 1. Plot 23 (40 x 40 m) |
| | | 2. Plot 19 (20 x 20 m) |
| | | 3. Plot 21 (10 x 10 m) |
| | | 4. Plot 50 (5 x 5 m) |
| | 6 | 1. Plot 29 (40 x 40 m) |
| | | 2. Plot 02 (20 x 20 m) |
| | | 3. Plot 48 (10 x 10 m) |
| | | 4. Plot 09 (5 x 5 m) |
| Oil palm (in distamce 8–10 m from tree agroforestry plots) | 0 | 1. Plot 23 (40 x 40 m) |
| | | 2. Plot 19 (20 x 20 m) |
| | | 3. Plot 21 (10 x 10 m) |
| | | 4. Plot 50 (5 x 5 m) |
| | | 5. Plot 29 (40 x 40 m) |
| | | 6. Plot 02 (20 x 20 m) |
| | | 7. Plot 48 (10 x 10 m) |
| | | 8. Plot 09 (5 x 5 m) |

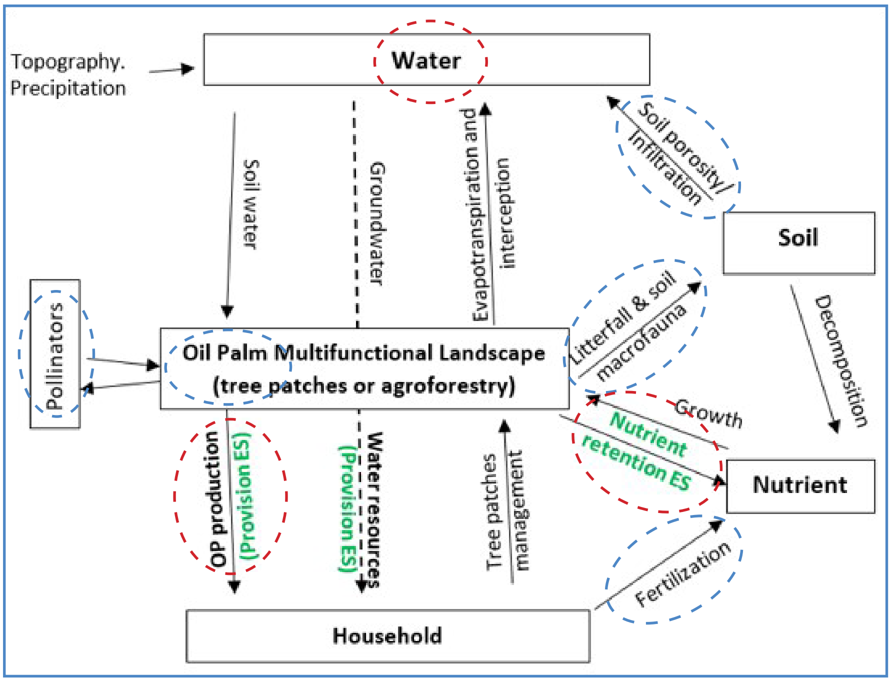
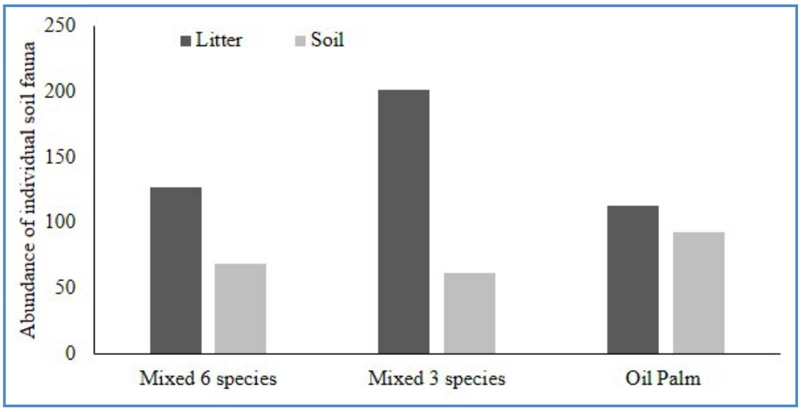
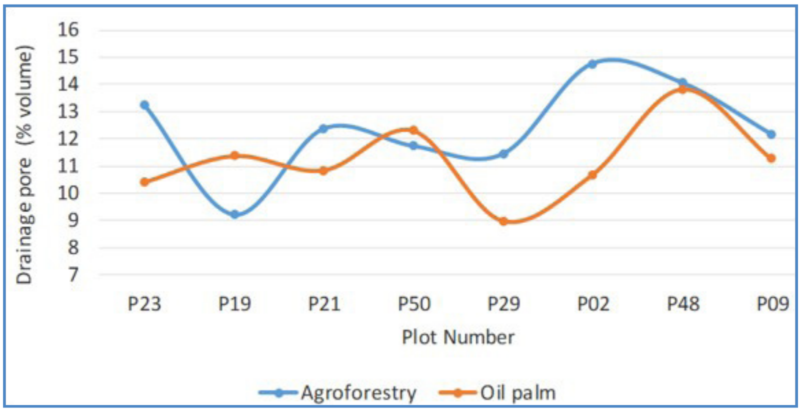



**Figure 1.** Relation between biodiversity parameter and ecosystem functions/services in oil palm multifunctionality landscape

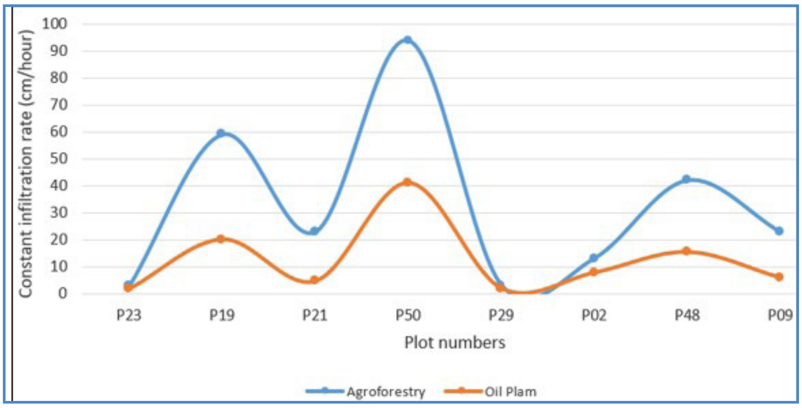
vegetation structure and arbuscular mycorrhizal fungi to see the relation between biodiversity parameters and ecosystem functions/services in oil palm agroforestry (Figure 1). For comparison we had also sampled similar parameters outside the agroforestry but within oil palm interrow. In total we measured 16 plots with different numbers of tree species and different plot sizes (Table 1).



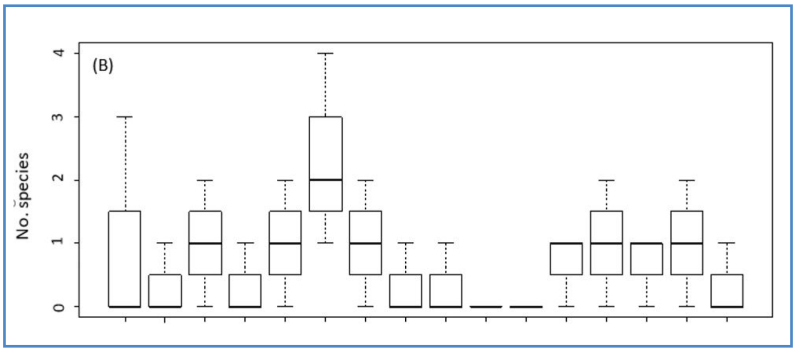

- Abundance of soil fauna tend to be higher in agroferestry
- Number of tree species has no impact on soil fauna abundance




- Soil porosity tend to be higher in agroforestry
- Number of tree species has no impact on soil porosity




- Infiltration tend to be higher in agroforestry
- Number of tree species has no impact on infiltration




- Pollinator's number of species tend to be higher in agroforestry
- Number of tree species has no impact on pollinator's number of species




GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Funded by DFG Deutsche Forschungsgemeinschaft

EFForTS

## Results and Conclusion

A total of 955 soil fauna were collected from agroforestry plots of six plant species, three plant species, and oil palm plantation. The number of individual soil fauna showed a consistent trend where litter had greater number of soil fauna compared to soil. There was an abundance of taxonomic group varieties of soil fauna. The order of Araneae is the most abundant in all plots. However, Hymenoptera was the major order in oil palm plantations. The diversity of soil fauna was significantly affected by vegetation, habitat (litter or soil), and the interaction among them. The diversity indices of soil fauna were compared between mixed vegetation and oil palm. The species richness of soil fauna was significantly higher in the agroforestry plot with three plant species compared to plots with different numbers of species. The diversity, for instance the Shannon index, showed greater results than in other plots.
In agroforestry, big pores are found more than in active oil palm rows and there is the tendency for infiltration to be higher in agroforestry than in active oil palm rows. We observed that there is linkage between soil porosity and higher abundance of soil fauna in the agroforestry plot.

In total, we have collected 44 species and 2241 individuals of ants, 8 species and 54 individuals of pollinators, and 138 species and 1115 individuals of parasitoids. Based on ANOVA, species richness of ants showed significantly different results in both plant diversity levels ($P=1.65\times10\text{-}5$) and plots ($P=0.0005$). Higher plant diversity plots are followed by higher ant species' richness. In contrast, ant abundance did not show a significantly different result in both plant diversity levels ($P=0.419$) and plots ($P=0.24$). In this research, we found a lack of abundance and richness in pollinator species. Pollinator species' richness did not show significantly different results based on plant diversity level ($P=0.442$) and plots ($P=0.301$). Same with its richness, pollinator abundance was not affected by different plant diversity levels ($P=0.587$) nor plots (0.146). The lack of pollinator presence may be caused by the haze from forest and land fires that happened during the research. Parasitoid species richness ($P=1.46\times10\text{-}5$) and abundance ($P=0.0009$) were significantly different between plots. This could have happened because parasitoid wasps live depending on their host and food source. Different plant diversity levels affected neither parasitoid species richness ($P=0.117$) nor abundance ($P=0.06$).



GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

Funded by Deutsche Forschungsgemeinschaft