CRC 990 - EFForTS

NEWSLETTER

Issue 3 / March 2015

Note / Acknowledgement from the Speakers

Dear CRC colleagues,

Due to the help of all of you we are very happy to be able to present the third issue of the Newsletter.

With this issue we are very happy and proud that we can present the amazing progress of the CRC in the last year. For the first time the newsletter presents virtually only results rather than infrastructural achievements documenting in an impressive way that the project took off very successfully. The amazing success is also reflected by the great variety of ABS projects funded in the framework of EFForTS and documented in this newsletter.

Enjoy reading!

Stefan Scheu (Speaker of the CRC 990),
Anas M. Fauzi (Speaker Indonesian Universtity Consortium of the CRC 990)

Content

I. Research Activities of the CRC 990 – State of the Art

1. Research activities of groups A, B, C, Z02 and INF

FIELDS OF RESEARCH

- Environmental processes (group A)
- Biota and ecosystem services (group B)
- Human dimensions (group C)
- Central Scientific Support Unit (Z02)

GROUP COORDINATORS

- **group A**: Alexander Knohl, Edzo Veldkamp (University of Göttingen, UGoe); Suria Darma Tarigan (Bogor Agricultural University, IPB); Damris Muhammad (UNJA)
- **group B**: Teja Tscharntke, Holger Kreft (UGoe); Leti Sundawati (IPB); Upik Yelianti (UNJA)
- **group C**: Meike Wollni, Heiko Faust (UGoe); Nunung Nuryartono (IPB); Rosyani (UNJA)

HIGHLIGHTS GROUP A

* First results from preliminary sweep netting in transformation systems highlight the potential of pollen analysis as a tool to unravel plant-insect pollinator interactions.
* Across all sites, the highest transpiration was observed in the most intensively managed oil palm plantation. On average, the estimated stand-level transpiration by oil palm plantations was as high as by forests.
* Preliminary results indicate that the mature oil palm plantation in PTPN acted as carbon sink, while results from the previous measurements in a non-productive oil palm plantation showed that it was a small carbon source.
* A new sub routine was developed for the land surface model CLM to include the specifics of oil palm simulation. The model is now tested against observation data from the measurements at PTPN VI – Batang Hari Unit.
* The Regional climate model WRF is installed at the German Climate Computing Center (DKRZ) in a 4-fold nesting approach to downscale the future climate scenario A1B to local level (3 km resolution) and to investigate the feedback between land transformation and regional climate.
* Our study shows strong losses of soil organic carbon in the topsoil after forest conversion to plantations. The losses are driven by a reduced carbon input and, in intensive plantations, by soil erosion.

Group A

A01

TITLE: **Prehistoric and historic rainforest transformations of the Jambi landscape**

TEAM: Principle Investigators: Hermann Behling (UGoe), Supiandi Sabiham (IPB), Asmadi Saad (UNJA), Yudhi Achnopha (UNJA)
Scientific staff: Siria Biagioni, Christina Ani Setyaningsih, Kartika Hapsari (PhD students)

PROGRESS / CURRENT STATUS

First manuscript on the Jaw SPT core analysis is under peer-review. In the manuscript, the long-term development of the peatland is discussed highlighting the relationship between vegetation community phases, hydrology, climate dynamics and peat (carbon) accumulation rate over time.
Results from sediment core Sungai Buluh B *(Kawasan hutan lindug gambut)* for pollen and spore (Kartika Hapsari), C/N content in collaboration with the ZMT (Centre for Marine Tropical Ecology, Bremen) and data loggers (Asmadi Saad) are now available.
Sediment core from Danau Njalau (Kerinci, Sumatra) currently under study for pollen and spore analysis by Christina Ani Setyan-

Team at work! Coring of sediment core Sungai Buluh B from Kawasan hutan lindug gambut, Jambi

ingsih for her PhD project. The aim is to reconstruct long-term vegetation succession of montane ecosystems after volcanic disturbance.

New sites in Jambi lowland cored for palaeoecological and palaeoenvironmental analysis: Muara Jambi Temple, Kebun Raya Bukit Sari and Mendahara Ilir.

42 pollen traps recovered from the core plots in 2014 under study for palynological analysis by Katharina Reuter for her master in UGoe. The aim is to quantify pollen yearly production of the vegetation taxa in the different transformation systems.

Pollen analysis of the experiment conducted in plots H01 and HR1 with two species of Trigona bees ongoing in collaboration with B09 (Rika Raffiudin and Rosi Fitri Ramadani). First results from preliminary sweep netting in transformation systems highlight the potential of pollen analysis as a tool to unravel plant-insect pollinator interactions (in collaboration with B09 (Kevin Darras).

Collaboration started with subproject B09 on the investigation of bats-plant interactions in rainforest and rainforest transformation systems.

A02

TITLE: **Tree and palm water use**

TEAM: Principle Investigators: Dirk Hölscher (UGoe); Herdhata Agusta, Hendrayanto (IPB); Heri Junedi (UNJA)
Scientific staff: Alexander Röll, Andrea Hanf, Niu Furong, Afik Hardanto (PhD students)

PROGRESS / CURRENT STATUS

Tree and palm sap flux was measured on the 32 core plots and at 15 additional locations (e.g. oil palm plantations of different age).

For oil palm, a sap flux method was calibrated and a sound sampling scheme was developed.

Across all sites, the highest transpiration was observed in the most intensively managed oil palm plantation.

On average, the estimated stand-level transpiration by oil palm plantations was as high as by forests.

The observed day-to-day fluctuations of transpiration were much lower in oil palms than in forest trees.

A manuscript was accepted for publication in Tree Physiology.

A03

TITLE: **Influence on local and regional climate**

TEAM: Principle Investigators: Alexander Knohl, Oleg Panferov (UGoe); Tania June (IPB); Heri Junedi (UNJA); Abdul Rauf (UNTAD); Dodo Gunawan (Badan Meteorologi Klimatologi, Dan Geofisika – BMKG)
Scientific staff: Ana Meijide, Andre Ringeler (Postdocs); Yuanchao Fan, Clifton Sabajo (PhD students), Edgar Tunsch (Technician)

PROGRESS / CURRENT STATUS

The climate tower is now installed at a 12 years old oil palm plantation in PTPN VI – Batang Hari Unit. Measurements at the tower have been running since March 2014. It is a 22m tower, equipped with full meteorological measurements, including a profile for air temperature and humidity and wind speed at different heights. We are performing CO_2 and H_2O measurements, both with eddy covariance at the top of the tower and using a profile system which measures concentrations at different heights. Preliminary results indicate that the mature oil palm plantation in PTPN acted as carbon sink, while results from the previous measurements in a non-productive oil palm plantation showed that it was a small carbon source.

Methane eddy covariance measurements started in August 2015.

Collaborations include the measurement by A05 of soil greenhouse gas emissions (carbon dioxide, methane and nitrous oxide) using the chamber technique in parallel to the eddy covariance measurements in PTPN VI. Additionally, oil palm water use was also measured in the tower location by A02, with the aim of comparing transpiration versus evapotranspiration in oil palms.

Investigation of surface biophysical characteristics such as surface roughness, transfer coefficient, intensity of turbulence, radiation interception and distribution, energy budget, microclimate and water fluxes across forest, young and mature oil palm plantation using remote sensing and micrometeorology (Tania June, IPB).

A new sub routine was developed for the land surface model CLM to include the specifics of oil palm simulation. The model is now tested against observation data from the measurements at PTPN VI – Batang Hari Unit.

The Regional climate model WRF is installed at the German Climate Computing Center (DKRZ) in a 4-fold nesting approach to downscale the future climate scenario A1B to local level (3 km resolution) and to investigate the feedback between land transformation and regional climate.

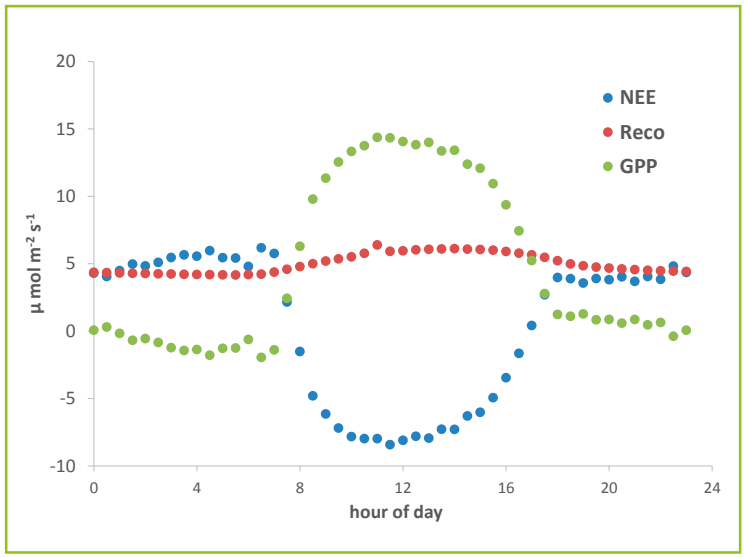


Fig. 1: Average diurnal cycles of net ecosystem exchange (NEE), ecosystem respiration (Reco) and Gross Primary Production (GPP) from July 2013 to February 2014 in the young oil palm plantation in Pompa Air.

A04

TITLE: **Stock, turnover and functions of carbon in heavily weathered soils under lowland rainforest transformation systems**

TEAM: Principle Investigators:
Yakov Kuzyakov (UGoe); Kukuh Murtilaksono (IPB); Muhammad Damris (UNJA)
Scientific staff: Thomas Guillaume (PhD student)

PROGRESS / CURRENT STATUS

The sub-project A04 has finished its sampling activities and main laboratory work. A first manuscript is accepted. The paper presents the results on soil organic carbon (SOC) losses after forest conversion to transformation systems (Fig. 2). The focus is set on two processes leading to SOC losses, 1) erosion and 2) decomposition, using carbon isotopic composition (Fig. 3). The second manuscript in preparation focuses on the consequences of SOC losses on carbon availability for soil microorganisms and how they might have adapted their ecological strategy. The end of the first phase of our subproject will be dedicated to the chemical/physical characterization of SOC and the SOC fluxes from the top soil to deeper layers. Beside our main topics, we collaborate on joint papers within the CRC in various fields such as farmer efficiency or water scarcity.

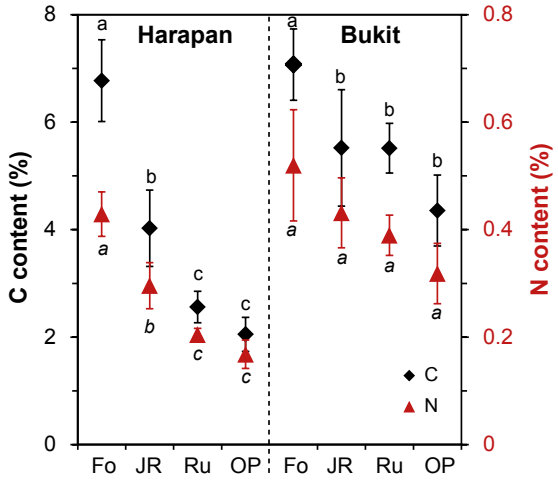


Fig. 3: Carbon and nitrogen contents in the Ah horizons under (Fo) forest, (JR) jungle rubber, (Ru) rubber and (OP) oil palm plantations in Harapan and Bukit regions. Values represent means±SE (n=4). Different letters show statistically significant differences (ANOVA, p<0.05).

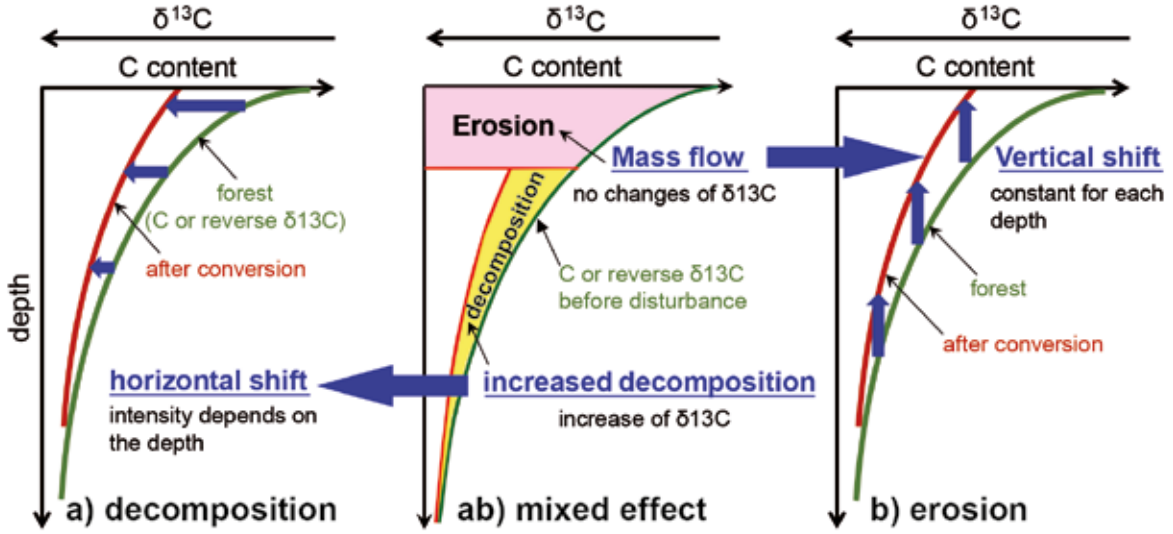


Fig. 2: Impact of forest conversion on the C content and $\delta^{13}C$ distributions in the soil depths (ab). Erosion and decomposition affect the depth distribution of the $\delta^{13}C$ and the C content in two different ways: a) stronger decomposition leads to higher $\delta^{13}C$ values and lower C contents. Graphically, this can be represented as a horizontal shift of the profiles under plantations compared to forest. The extent of this shift is not the same for each depth and each parameters. (b) Erosion leads to a vertical shift of the same extent of all soil parameters closer to the surface, allowing the discrimination of both processes.

HIGHLIGHTS GROUP B

* Severe losses in macro-invertebrate species richness (45 % loss), animal density (48 % loss) and biomass (52 % loss) were found from forest to oil-palm systems. Community energy fluxes decreased significantly and communities shifted from predator to omnivore dominance.

* The diversity analysis of the soil prokaryotic communities showed that prokaryotic communities, against expectations, are more diverse in plantations compared to rainforest. The differences were partially related to variations in soil properties such as pH and P content.

* Intraspecific diversity of dominant vascular plants show highest mean intraspecific diversity values (Shannon Index) for the systems Forest and Jungle Rubber. Intensive managed systems like plantations consist of species with a low intraspecific variability, which explains the lower results for Rubber and Oil Palm plots.

* C storage in woody biomass is significantly higher in the more natural and diverse systems (natural lowland rainforest, jungle rubber) than in more intensively managed and less diverse systems (rubber and oil palm plantations). The total C pools in forest are more than four times higher than in oil palm plantations. Oil palm showed the highest fine root litter production of all systems.

* Forest has the highest level of plant diversity at all levels of analysis (alpha-, beta-, and gamma-diversity) followed by jungle rubber agroforestry systems. Oil palm plantations in turn are characterized by a high abundance of herbaceous plant individuals, but low species numbers and low beta diversity. Rubber plantations have the lowest densities and species richness, but show higher beta diversity compared to oil palm plantations. While forest is almost entirely composed by native species, all three transformation systems show high numbers of invasive plant species.

* Ectomycorrhizas were rare and only detected in jungle rubber and lowland rain forest. Arbuscular mycorrhizal root colonization was abundant and generally unaffected by the land use system. Barcoding revealed high abundances of members of the AM family Glomeraceae, especially Glomus sp. Root vitality was lower and spore abundance higher in oil palm plantations than in other land use systems.

* Species richness and density of microfauna (testate amoebae, protista) in oil palm and rubber plantations were lower compared to forest and jungle rubber. Species richness of mesofauna predators (Mesostigmata, Acari) decreased from forest to jungle rubber to rubber to oil palm plantations. Indicators of microbial decomposition processes (basal respiration, microbial biomass) and resource availability (specific respiration) were generally higher in soil of rainforest and jungle rubber than in rubber and oil palm plantations.

* In oil palm plantations, the diversity of predatory ants and Orthoptera, which are the most significant insect predators, is affected by the bordering land-use. Secondary forest has the best value for oil-palm pest management, but jungle rubber, weedy oil palm, and weedy rubber borders are also valuable for controlling leaf-defoliators. Combining border and weedy plants inside the plantation could benefit biological control.

* A landscape generator was developed that produces artificial land-use maps and land-ownership maps. The output maps produced by this landscape generator will be used as input for the dynamic ecological-economic model.

* The mode of reproduction and seed dispersal mechanisms are important factors for weed abundance.

Group B

B01

TITLE: **Structure, stability and functioning of macro-invertebrate communities in rainforest transformation systems in Sumatra (Indonesia)**

TEAM: Principle Investigators: Ulrich Brose (UGoe); Achmad Farajallah, Tri Heru Widarto, Noor Farikhah Haneda (IPB)
Scientific staff: Andrew Barnes, Malte Jochum (PhD students), Lucas Jurkschat (Master student)

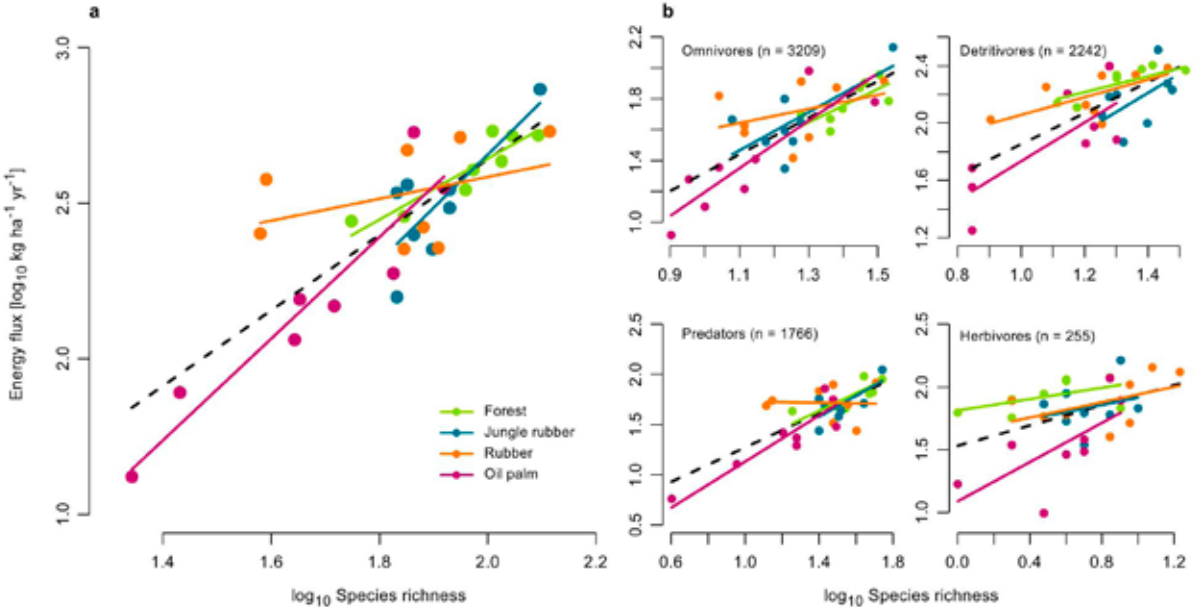


Fig. 4: Community energy flux in response to species richness. Linear mixed effects models for communities (a) and their functional feeding guilds (b). Black dashed lines show overall model fits, colored lines indicate different land-use systems (Barnes et al. 2014).

PROGRESS / CURRENT STATUS

We analysed consequences of the globally important land-use transformation from tropical forests to oil palm plantations. Species diversity, density and biomass of invertebrate communities suffer at least 45% decreases from rainforest to oil palm. Combining metabolic and food-web theory, we calculated annual energy fluxes to model impacts of land-use intensification on multitrophic ecosystem functioning. We found a 51% reduction in energy fluxes from forest to oil palm communities.

Species loss clearly explains variation in energy fluxes; however, this relationship depends on land-use systems and functional feeding guilds, whereby predators are the most heavily affected. Biodiversity decline from forest to oil palm is thus accompanied by even stronger reductions in functionality, threatening to severely limit the functional resilience of communities to cope with future global changes.

B02

TITLE: **Impact of rainforest transformation on phylogenetic and functional diversity of soil prokaryotic communities in Sumatra (Indonesia)**

TEAM: Principle Investigators: Rolf Daniel (UGoe); Nisa Mubarik, Iman Rusmana, Anja Meryandini (IPB)
Scientific staff: Dominik Schneider (Postdoc)

PROGRESS / CURRENT STATUS

Prokaryotes are the most abundant and diverse group of microorganisms in soil. Soil microorganisms mediate nearly all biogeochemical cycles in terrestrial ecosystems and are responsible for most nutrient transformations in soil, thereby, influencing the aboveground plant diversity and productivity. In this subproject, the impact of lowland rainforest transformation on diversity and ecosystem function of soil prokaryotic communities is investigated. To identify changes in indigenous gene- and taxon-specific patterns and key metabolic functions accompanying rainforest transformation, comparative phylogenetic and functional profiling of soil microbial communities from lowland rainforest, jungle rubber, rubber plantations, and oil palm plantations were performed. We compared soil prokaryotic (Bacteria and Archaea) community composition, diversity and function of the four systems by culture-independent DNA-based metagenomic (entire community level) and RNA-based metatranscriptomic (active community level) approaches at all core sites. The analysis of the prokaryotic communities within the different transformation systems revealed the main bacterial and archaeal groups and differences between the systems. Landscape differences in community diversity were also recorded. The diversity analysis of the soil prokaryotic communities showed that prokaryotic communities, against expectations, are more diverse in plantations compared to rainforest (Fig. 5). The differences were partially related to variations in soil properties such as pH and P content.

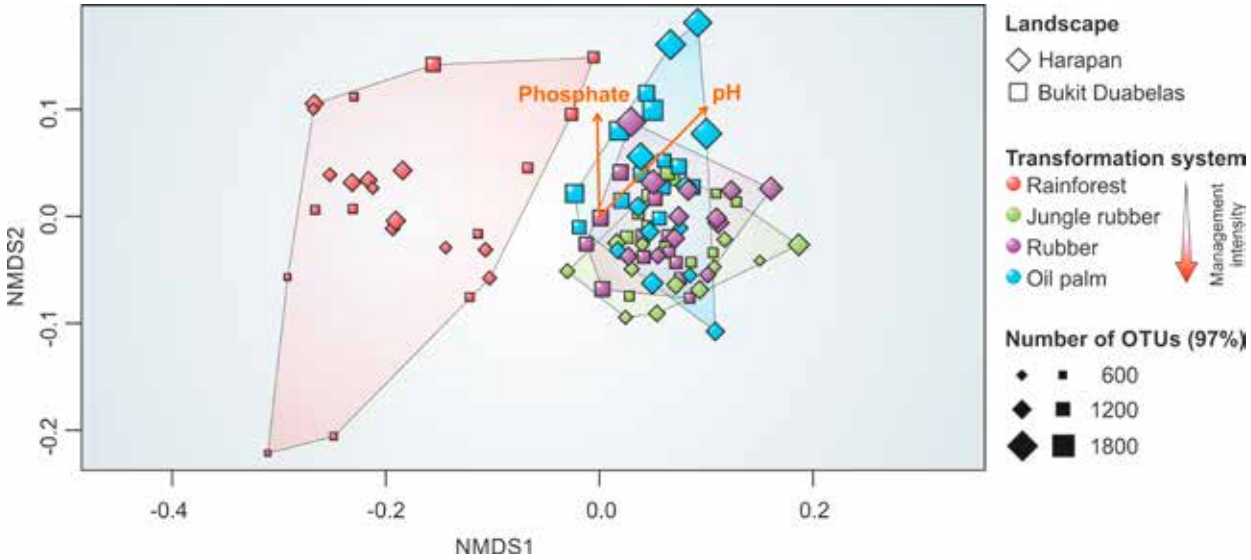


Fig. 5: Non-metric Multidimensional Scaling (NMDS) of bacterial community composition of the investigated transformation systems in Jambi at subplot level. NMDS was based on weighted Unifrac distance matrix, which takes into account abundance of species and phylogenetic relation. Red arrows indicate correlated environmental variables and point in direction of increased pH and phosphate concentrations, respectively. Clustering of sampling sites according to transformation system is highlighted.

B03

TITLE: **Plant genetic diversity in tropical lowland rainforest transformation systems**

TEAM: Principle Investigators: Reiner Finkeldey (UGoe); Iskandar Z. Siregar (IPB); Sri Rahayu, Ulfah J Siregar, Utut Widyastuti, Hamzah Saidina, Zainuddin Zulkarnain, Bambang Irawan (UNJA)
Scientific staff: Natalie Breidenbach (PhD student)

PROGRESS / CURRENT STATUS

The aim of this project is to study the consequences of rainforest transformation at the level of intraspecific diversity and to assess intraspecific diversity in different transformation systems by the investigation of dominant vascular plant species with different taxonomic and phylogenetic positions and life history traits. We altogether sampled 3200 individuals in the 32 core plots and completed with genotype scoring (AFLP method) for 3000 samples. Preliminary results show highest mean intraspecific diversity values (Shannon Index, see Fig. 6) for the systems Forest and Jungle Rubber. Intensive managed systems like plantations consist of species with a low intraspecific variability, which explains the lower results for Rubber and Oil Palm plots. Variance between plots and the four systems are due to the different dominant species present. Harapan and Bukit Dua Belas landscapes show similar results.

Currently there is one bachelor thesis at IPB ongoing about leaf variation of Alstonia scholaris and Macaranga bancana and one bachelor thesis at University of Göttingen about genetic population structure of the epiphytic fern Nephrolepis acutifolia in Oil Palm plantations.

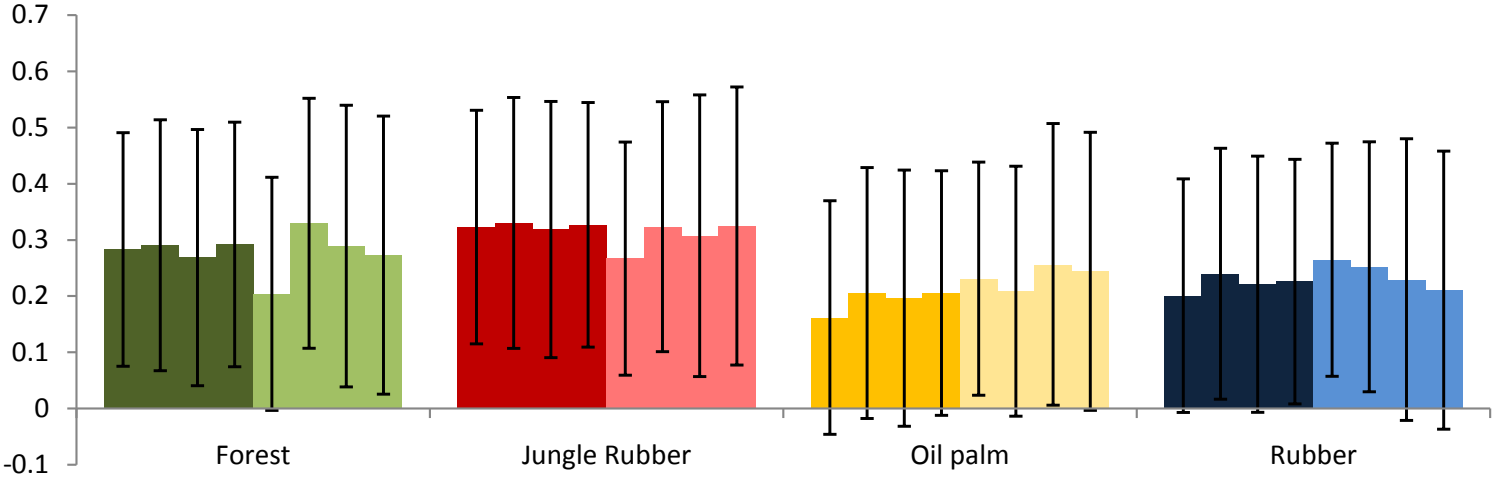


Fig. 6: Mean Shannon Index with standard deviation of 10 species per plot. Dark colours present Harapan Landscape, light colours Bukit 12 Landscape.

B04

TITLE: **Carbon sequestration, litter C input to the soil, and resource use-efficiency**

TEAM: Principle Investigators: Dietrich Hertel, Christoph Leuschner (UGoe); Cecep Kusmana, Triadiati Antono, Elias (IPB); Rahmi Dianita (UNJA)
Scientific staff: Bernhard Schuldt (Postdoc); Martyna Kotowska, Yasmin Abou Rajab (PhD students)

PROGRESS / CURRENT STATUS

All field work activities are completed. Currently we are working on sample analysis in the lab in Göttingen, data analysis and publication of the first results.

We could confirm our first working hypothesis that C storage in woody biomass is significantly higher in the more natural and diverse systems (natural lowland rainforest, jungle rubber) than in more intensively managed and less diverse systems (rubber and oil palm plantations). The total C pools in forest are more than four times higher than in oil palm plantations.

The natural forest and jungle rubber showed higher litter C input than rubber monoculture. Surprisingly oil palm plantations also produce large amounts of litter, however due to crop removal the nutrients are not returned to the soil. The nutrient use efficiency is similar in natural forests and jungle rubber plantations, however it showed lowest values in oil palm plantations possibly due to highly fertilized soils. Furthermore, oil palm showed the highest fine root litter production of all systems.

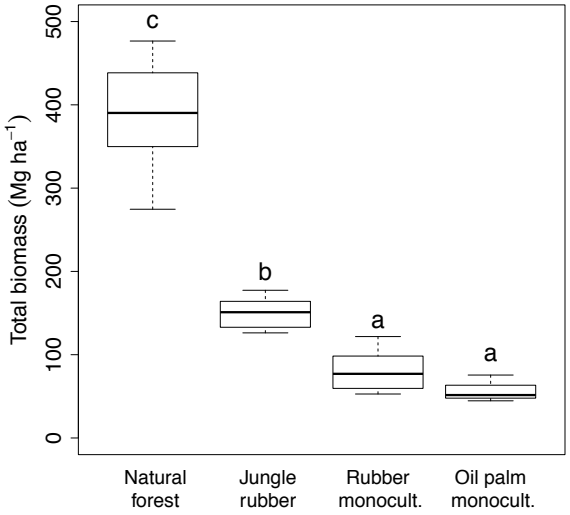


Fig. 7: Total biomass (Mg ha^{-1}) of the four land-use systems in Jambi, Sumatra. Shown are means ± SE (n = 8). Lower case letters indicate significant differences between systems according to Tukey HSD tests ($p < 0.05$).

B05

TITLE: **Methodological approaches to the assessment of all tree resources in transition systems in forested tropical landscapes**

TEAM: Principle Investigators: Christoph Kleinn (UGoe); I Nengah Surati Jaya, Tatang Tiryana (IPB); Muhammad Zuhdi (UNJA)
Scientific staff: Lutz Fehrmann, César Pérez-Cruzado (Postdocs); Dian Nuraini Melati (PhD student)

PROGRESS / CURRENT STATUS

The tree inventories planned at four different transformation systems have been completed. Further work related to above ground biomass estimation required the identification of wood specific gravity per species. The compilation of such information for B05 inventory plots (together with CRC 990 core plots) is being conducted in collaboration between B04, B05 and B06 via ABS funds.

Land use/land cover (LULC) mapping for the years 1990, 2000, 2011, and 2013 was done. This work was carried out by the team of our IPB counterparts under the coordination of Prof. I Nengah Surati Jaya within an ABS project. The maps were derived from visual interpretation of Landsat images and guided by ground truth, Rapid Eye images

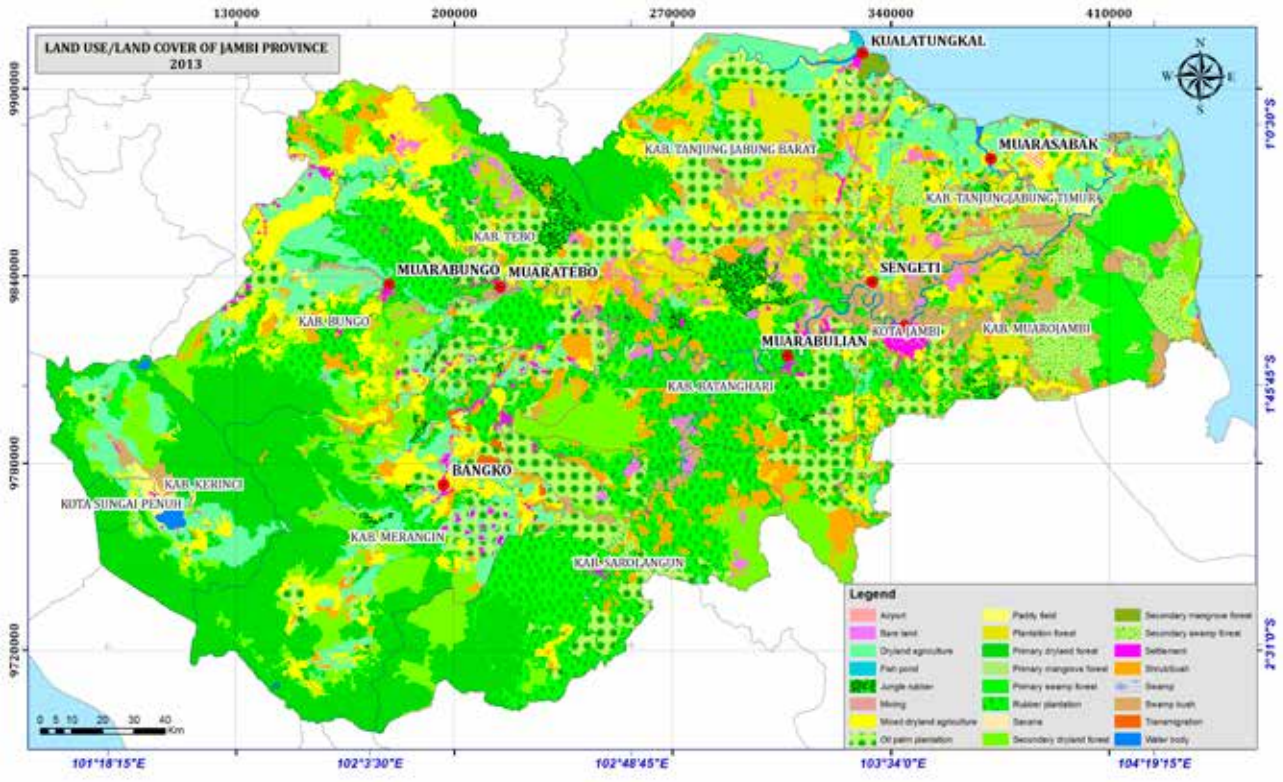


Fig. 8: Land use/land cover map of Jambi Province for 2013

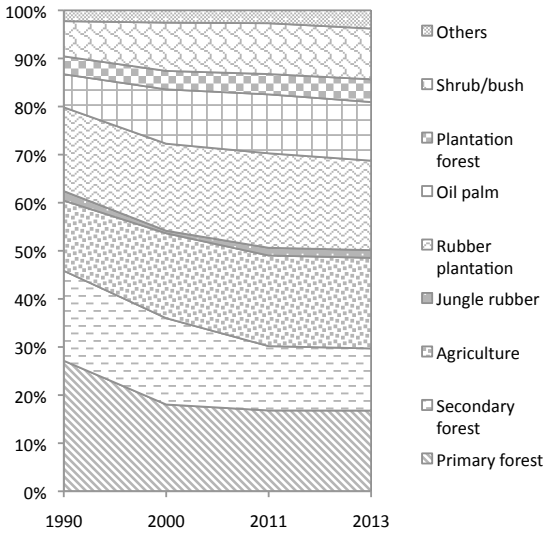


Fig. 9: Land use/land cover composition of Jambi Province in 1990, 2000, 2011, and 2013

from 2013, and the land cover classification system as commonly used by the Ministry of Forestry of Indonesia.

A further study on the historical changes of LULC and its spatial pattern indicated that primary and secondary forest cover declined over time. On the other hand, agricultural area, rubber and oil palm plantation have been considerably expanded. The results showed a different level of specialization at different scales, as the LULC diversity observed at the province level contrasts with the high specialization in estate crops at village level in the study area. The spatial pattern of the land use change also showed the decline of mean patch size and the aggregation in secondary forest at the expense of the increase of the mean patch size in oil palm plantation and highly fragmented rubber plantations.

B06

Assessment of epiphytes in crown of trees.

TITLE: **Plant diversity**

TEAM: Principle Investigators: Holger Kreft (UGoe); Hardianto Mangopo (IPB/UGoe); Sri Sudarmiyati Tjitrosoedirdjo, Indah Wahyuni (IPB); Bambang Haryadi (UNJA)
Scientific staff: Katja Rembold (Postdoc)

PROGRESS / CURRENT STATUS:

Plot-based species inventories on all 32 core plots were finished in August 2014. On all core plot, a total of 3,552 individual trees with a diameter at breast height ≥10 cm were identified and measured (position, height, crown structure). Additionally, all vascular plant individuals growing within subplots were identified and measured (height). Samples were collected and herbarium specimens prepared for identification and later deposition at several Indonesian herbaria (Herbarium Bogoriense, BIOTROP Herbarium, UNJA Herbarium, Harapan Rainforest Herbarium). In addition to our work on the core plots, we established 120 epiphyte plots with 30 plots in each of the four transformation systems. Each plot measured 20 x 20m and contained one host tree (phorophyte) which was examined for presence and abundance of vascular epiphytes.

A total of 6,866 herbarium specimens from 5,238 plant individuals were collected and prepared. All herbarium specimens have already been sent to the herbarium at BIOTROP in Bogor where they are currently identified, labeled, and mounted on herbarium sheets. About 1,050 herbarium specimens are already processed. Our preliminary checklist currently includes 2,075 species and morphospecies of vascular plants including 79 epiphyte species. Species identification is still ongoing and will be one of the main tasks in 2015. About 80,000 standardized, high-quality photographs of all collected specimens were taken. For the calculation of canopy openness and light intensity on the plots, hemispherical photographs and PAR measurements have been taken at 32 positions within all 32 core plots in both landscapes (in close cooperation with subprojects B04, B05, Z02). We are currently working on the first version of an online plant database that provides access to taxonomic, phylogenetic, functional, and biogeographical data and photographs for all plant species in our study sites. A first version of this web tool will already go online during the first project phase and we intend to extend it in the following phases. The online database provides a useful tool for all plant-related EFForTS subprojects as well as for anybody else working on SE-Asian plants. Three manuscripts focusing on general plant diversity patterns, epiphyte diversity between the transformation systems and epiphyte diversity along an age gradient are currently in preparation.

Preliminary results

Within the 32 core plots, a total of 2,075 species and morphospecies of vascular plants were identified including 1,068 trees, 541

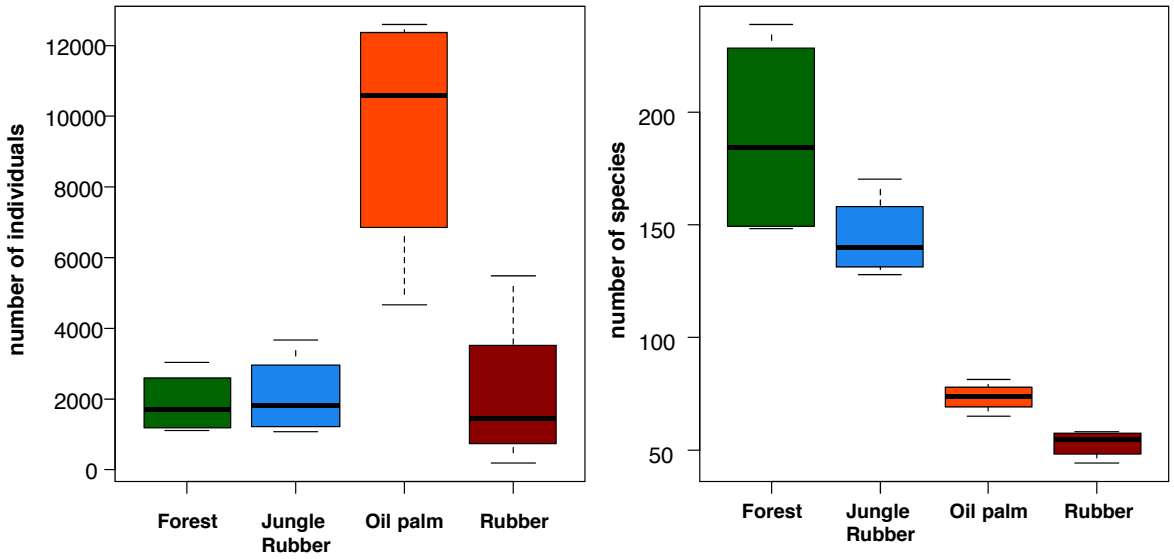


Fig. 10: Difference in the number individuals and species between the four transformation systems at the core plot level from the Bukit Duabelas landscape.

(partly climbing) shrubs, 388 herbs and 77 species that we only found as seedlings. The most species-rich families are Rubiaceae (160 species), Annonaceae (114 species), Myrtaceae (95 species), Fabaceae and Phyllanthaceae (93 species each). Preliminary analyses suggest that forest has the highest level of plant diversity at all levels of analysis (alpha-, beta-, and gamma-diversity) followed by jungle rubber agroforestry systems (Fig. 9). Oil palm plantations in turn are characterized by a high abundance of herbaceous plant individuals, but low species numbers and low beta diversity. Rubber plantations have the lowest densities and species richness, but show higher beta diversity compared to oil palm plantations. While forest is almost entirely composed by native species, all three transformation systems show high numbers of invasive plant species.

Epiphyte studies

In the 120 epiphyte plots, we recorded a total of 3,955 individuals of vascular epiphytes belonging to 79 species and 20 families. Additionally, we found high numbers of terrestrial plant species (particularly Clidemia hirta, Asystasia gangetica, Hevea brasiliensis, Elaeis guineensis) growing as accidental epiphytes on the stems of oil palms. Highest species numbers were found in forest (44 species) and jungle rubber (46 species) while the number of families was higher in forest (15 families) than in jungle rubber (9 families). Jungle rubber and oil palm plantations were both characterized by a high abundance of epiphytes. Despite the relatively high abundance, oil palm plantations had the lowest epiphyte species diversity (10 species, 7 families), closely followed by rubber plantations (11 species, 6 families). Among the possible drivers of higher species diversity in forest and jungle rubber compared to the plantation systems is a wider range in microclimatic conditions that we measured from the ground to the forest canopy. Additionally, age and structure of the host trees might be important. For instance, epiphyte diversity in oil palm plantations increases significantly with age of the oil palms and the epiphyte community undergoes a succession that is influenced by changes in substrate availability on oil palm trunks with palm age. Additionally, we could show that epiphyte cover is a driver for arthropod abundance and diversity living in organic matter in the leaf axils of oil palm trunks.

B07

^{15}N-labeling in forest (A) and oil palm plantation sites (B)

TITLE: **Characterization of soil and root fungal communities along a tropical land-use gradient**

TEAM: Principle Investigators: Andrea Polle (UGoe); Sri Wilarso Budi (IPB); Bambang Irawan, Upik Yelianti (UNJA); Henry Barus, Efi Toding (UNTAD)
Scientific staff: Nur Edy, Josephine Sahner (PhD students)

PROGRESS / CURRENT STATUS

We are working on the following work packages: (i) bar coding of root and soil fungal communities and their relation to root (nutrients, vitality, mycorrhizal colonization spore abundance) and to some soil properties (pH, nitrogen, carbon) (ii) preferences of arbuscular mycorrhizal fungal species for distinct host species, (iii) comparison of uptake of nitrogen by root communities in rain forests and oil palm plantations and (iv) nitrogen acquisition from leaf and root litter. For (i) we included the 32 core plots (lowland rainforest, jungle rubber, rubber, and oil palm plantations) and applied 454 pyrosequencing in addition to trait analyses. The analyses are conducted in collaboration with UNTAD (Henry Barus) and IPB (Sri Wilarso Budi) and partners from Göttingen University (Marife Corré (A05) and Rolf Daniel (B02). (ii) Roots from all land use systems are included and used for the determination of plant (in collaboration with Reiner Finkeldey Z02) and AM species. (iii) A 15N labeling experiment has been conducted in collaboration with Jambi University (Upik Yelanti, Bambang Irawan) and the samples were transported to Göttingen. (iv) The plants for the experiment are being grown and prepared for labeling with 15N at Jambi University (collaboration Bambang Irawan and Upik Yelanti).

Results

Ectomycorrhizas were rare and only detected in jungle rubber and lowland rain forest. Arbuscular mycorrhizal root colonization was abundant and generally unaffected by the land use system. Barcoding revealed high abundances of members of the AM family Glomeraceae, especially Glomus sp. Root vitality was lower and spore abundance higher in oil palm plantations than in other land use systems. Our study clearly demonstrates a decline in nutrient elements, especially of nitrogen and enrichment in potentially toxic compound (iron, aluminium) in oil palm roots compared with those in other land use systems. We used the performance and element data to develop land use indices for roots. The pyrosequencing approach revealed high diversities of soil fungi and identified as well some AM species of the family Acaulosporaceae and Glomeraceae.

Outlook

Comparison of the soil and root fungal diversity in relation to transformation systems and nutrient status of roots. Further processing of WP2 and WP3.

B08

TITLE: **Structure and functioning of the decomposer system in tropical lowland rainforest transformation systems**

TEAM: Principle Investigators: Stefan Scheu, Mark Maraun (UGoe); Rahayu Widyastuti (IPB); Wilyus Wilyus (UNJA)
Scientific staff: Bernhard Klarner, Valentyna Krashevska (Postdocs)

PROGRESS / CURRENT STATUS

Sampling of all forest and transformation sites is completed. Abiotic and microbial measurement are performed. Microfauna, meso- and macrofauna analyses are completed or in progress.

Litterbags for "Litter exchange experiment" and "Ant exclusion experiment" are installed; decomposition rate of litter after 6 and 12 month for first experiment and after 6 month for the second are measured.

Species richness (Fig. 11a) and density of microfauna (testate amoebae, protista) in oil palm and rubber plantations were lower compared to forest and jungle rubber. Species richness of mesofauna predators (Mesostigmata, Acari) (Fig. 11b) decreased from forest to jungle rubber to rubber to oil palm plantations; also, densities were lower in plantations compared to rainforest. Decomposition rates in monoculture systems were slower compared to forest and jungle rubber (Fig. 11c). Indicators of microbial decomposition processes (basal respiration, microbial biomass) and resource availability (specific respiration) were generally higher

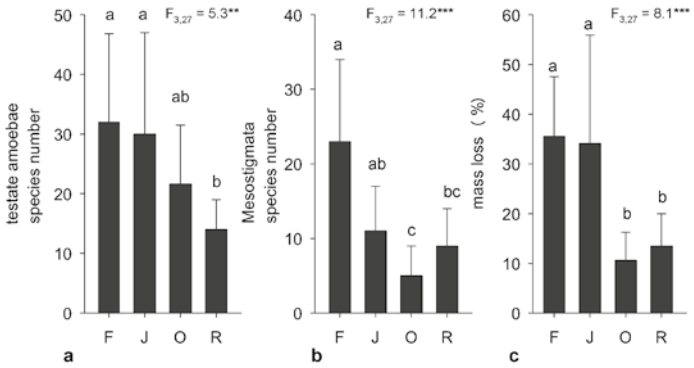


Fig. 11: Testate amoebae species number (a), Mesostigmata species number (b) and mass loss of forest litter (c) in rainforest (F), jungle rubber (J), oil palm (O) and rubber plantations (R)

Picture from left to right: Rahayu Widyastuti (IPB), Bernhard Klarner (UGoe), Yayuk Suhardjono (LIPI), Valentyna Krashevska (UGoe)

in soil of rainforest and jungle rubber than in rubber and oil palm plantations (Krashevska et al. submitted).

Decreasing density and diversity of different functional groups of soil animals indicate negative effects of rainforest conversion on the overall structure of the decomposer community. Additionally, decreasing litter decomposition rates and disturbance of the soil microbial communities with land use intensification indicate a reduction of ecosystem services provided by the decomposer system. This loss of functions likely is related to decreased tree diversity and associated changes in habitat structure, altering biotic and abiotic driving factors of the decomposer system.

Current field activities:

Root/mycorrhiza exclusion experiment is installed in February 2015.

B09

Dicaeum trigonostigma caught by mist-netting (@ Arite Hildebrandt).

TITLE: **Aboveground patterns of biodiversity and associated ecosystem functions across tropical rainforest transformations systems**

TEAM: Principle Investigators: Teja Tscharntke, Yann Clough (UGoe); Damayanti Buchori, Akhmad Rizale (IPB);
Scientific staff: Kevin Darras, Lisa Denmead, Fuad Nurdiansyah (PhD students)

PROGRESS / CURRENT STATUS

We focus on aboveground animal biodiversity patterns and related ecological functions in lowland forest, jungle rubber, rubber plantations and oil palm plantations. Subproject B09 studies invertebrates (Fuad Nurdiansyah), ants (Lisa Denmead) and birds (Kevin Darras).

We analyzed animal diversity patterns in the different land-use systems. Ant species richness does not change between transformation systems, but ant community composition shows clear differences between the systems. Bird call activity is much higher in the forest, and species richness decreased

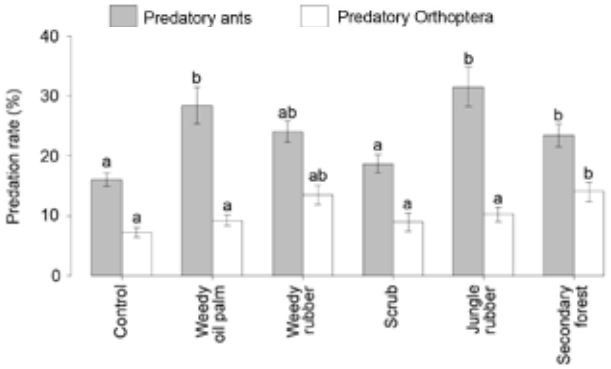


Fig. 12: Insect predation rate on dummy caterpillar in different types of borders.

with transformation, while omnivorous birds increased and frugivores disappeared. We analysed birds' diets to construct trophic networks with arthropods and plants. In Jambi city, we show that citizen prefer captive-bred birds, but the massive trade puts pressure on local bird populations.

In oil palm plantations, the diversity of predatory ants and Orthoptera, the most significant insect predators, is affected by the bordering land-use. Secondary forest has the best value for oil-palm pest management, but jungle rubber, weedy oil palm, and weedy rubber borders help to control leaf-defoliators. Weedy plants inside the plantation also benefit biological control.

In young oil palm plantations, the bird, bat and ant exclusion experiment shows their influence on herbivory and predation rates. However, the effect on yield is unclear and may appear with a delay.

B10

TITLE: **Landscape-level assessment of ecological and socio-economic functions of rainforest transformation systems**

TEAM: Principle Investigators: Kerstin Wiegand, Katrin Meyer, Jann Lay (UGoe); Surya Tarigan Alinda Zain, Ernan Rustiadi (IPB); Sunarti (UNJA)

Scientific staff: Claudia Dislich (Postdoc); Elisabeth Hettig, Fuad Nurdiansyah (PhD students)

PROGRESS / CURRENT STATUS

Developing a coupled ecological-socio-economic simulation model:

- Economic household model: We analyzed data from the household survey (C07) to derive model parameters for the production function of our economic household model. The model considers both oil palm and rubber production of smallholder households.
- Landscape generator: We further developed a landscape generator that produces artificial land-use maps and land-ownership maps. The output maps produced by this landscape generator will be used as input for the dynamic ecological-economic model (see Fig. 13).
- Review of ecosystem functions in oil palm plantations: based on an extensive literature search we review regulating, habitat, production and information functions of oil palm plantations (work in progress).
- Empirical relationship between land-use types and ecosystem services of water flow regulation in a watershed with rapid expansion of plantation crops (work in progress).

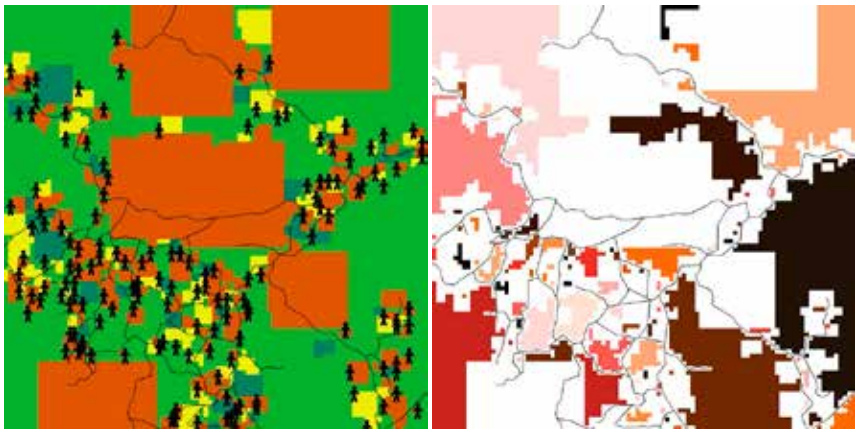


Fig. 13: Snapshots of the landscape generator model: left panel shows a landscape with smallholder fields and larger plantations; different colors represent different land-use types. Right panel shows the same landscape, different colors represent contiguous habitat patches.

B 12

TITLE: **Reproductive strategies of flowering plants in tropical rainforest transformation systems**

TEAM: Principle Investigators: Elvira Hörandl (UGoe); Sri Sudarmiyati Tjitrosoedirdjo (IPB and South East Regional Centre for Tropical Biology – BIOTROP), Sri Rahayu (Lembaga Ilmu Pengetahuan Indonesia – LIPI)
Scientific staff: Ladislav Hodac (Postdoc); Nicole Opfermann (PhD student); Fuad Bahrul Ulum (Master student), Swantje Freund (Bachelor student)

Left: *Clidemia hirta* (Melastomataceae); Right: *Centotheca lappacea* (Poaceae), (@ Nicole Opfermann)

PROGRESS / CURRENT STATUS

The project aims at investigating mode of reproduction in weedy plants in the understory of plantations. Our focus is on the occurrence of invasive species, and their ability to spread via asexual reproduction in human-influenced transformation systems. Furthermore, we want to understand the impact of these weeds on ecosystem services and their impact on farming. We sampled eight species for analysis of mode of seed formation and population genetic analysis in oil palm, rubber plantation and in jungle rubber plots; in natural rainforests, we recorded their presence/absence. Preliminary results suggest that mode of reproduction and seed dispersal mechanisms are important factors for weed abundance, but various different reproductive strategies appear to be successful. The most abundant invasive herb, Clidemia hirta, introduced from Central America, occurs regularly in all systems and even in natural forests. The plant reproduces clonally via asexually formed seeds. Seed set is pollinator-independent and enhanced by polyembryony and a mean germination rate of 72 percent. Population genetic studies based on 7 microsatellite loci suggest that the species colonized all systems with a few clones. Among the grasses, the most abundant species (Centotheca lappacea) reproduces sexually, but appears to have a highly efficient seed dispersal mechanism which is also reflected in population genetic structure (Ulum, 2014; Hodac et al., subm.; collaboration with B03). Further work is currently conducted on mode of reproduction and genetic diversity of two more grass species (Paspalum conjugatum and Paspalum orbiculare) and on genetic diversity of two herbs (Chromolaena odorata & Mikania micrantha). First results showed that Paspalum orbiculare seems to be polyploid and reproduces asexuelly via apomixis. For Chromolaena, 10 polymorphic microsatellite loci could be established. We further identified the presence/absence of the ten most abundant herbaceous alien species in all plots to develop a hemeroby index for the transformation systems (collaboration with B06). At least four of these species are apomictics. Results suggest that detailed investigations of mode of reproduction are necessary to understand spread and abundance of weedy plants.

HIGHLIGHTS GROUP C

* Long-term consequences of overlapping, conflicting land regulations remain, creating uncertainty and the tendency of local actors to dynamically negotiate rules leading to ambivalent natural resource management approaches.
* At the heart of today´s land contestations are access and property relations. Access to land is subject to contestations and struggles resulting from competing and ambivalent institutional regimes and power asymmetries. This has direct effects on peoples´ agency to respond to changes in the politico-legal and social framework. Local actors often engage with discourses at different scales in order to enhance their agency.
* Local land conflicts are increasingly influenced by transnational governance arrangements (REDD+) for mitigating climate change. The emergence of REDD+ leads to a new transnational scale of forest governance altering dialectical relationships between structure and agency.
* Differences in land use and social structures can be found between the Bukit Duabelas and Harapan research regions. These differences have their origin in pre-colonial socio-political organization that until today facilitated different developments of access to land and land use transformation.
- In both research regions land has become a scarce and contested resource sought after by various actors. At the same population density in rural Jambi is constantly increasing through to unassisted in-migration closely intertwined with land use change and cash crop economy. Migrants originate from different parts of Sumatra and other Indonesian islands; accordingly the scope of cultural backgrounds of the people living there becomes more and more variegated.
- Studies on carbon footprint of households in Jambi and Central Sulawesi showed that household income is the main driver of emissions, with fuel-light consumption and other energy expenditures being the major contributors.
- In rubber farming, production inputs have a significant influence on production risk. Results indicate that moderate risk-averse farmers cultivate palm oil more often and also have bigger palm oil plantation than strongly risk-averse and risk-seeking farmers.

Group C

C01

TITLE: **Smallholder productivity, market access, and international linkages in rubber and palm oil production in Jambi Province**

TEAM: Principle Investigators: Bernhard Brümmer (UGoe); Rina Oktaviani, Dedi Budiman Hakim (IPB); Zulkifli Alamsyah, Raja Sharah Fatricia (UNJA); Sudarmiyati Tjitrosoedirdjo (Biotrop)

Scientific staff: Anna Mareike Holtkamp, Thomas Kopp (PhD students)

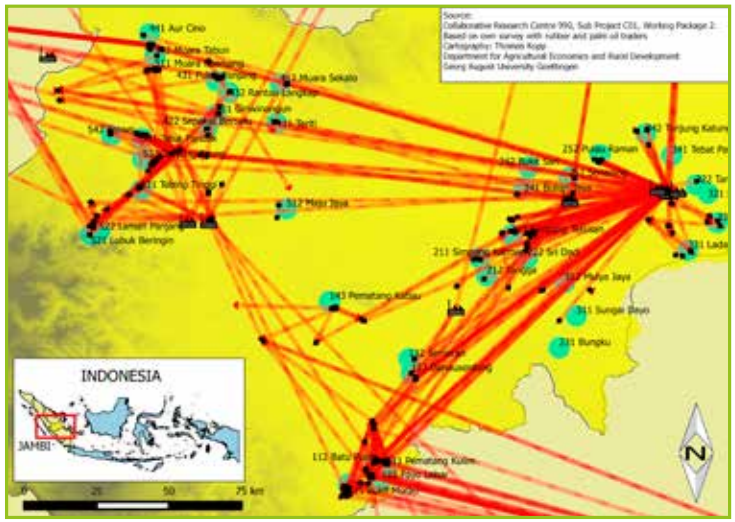


Fig. 14: Trade flows of rubber in the Jambi Province. Source: Own production, based on original survey data. Borders of Jambi and Sumatra from Center for International Forestry Research, surface of Jambi from NASA / EOSDIS.

PROGRESS / CURRENT STATUS

The research paper based on CRC Discussion Paper 3 („Have Indonesian Rubber Processors Formed a Cartel?") was presented at two conferences: The IAMO Forum in July 2014 in Halle an der Saale, Germany, and the EAAE Conference in August 2015, in Ljubljana, Slovenia). The improved manuscript is currently under review.

A second paper, focussing on the market power of small traders of rubber in Jambi is at a final stage. The data analysis has been completed, and a final draft compiled. It is now under preparation to appear in the CRC990 discussion paper series. Figure 14 shows a map of rubber trade flows along the local value chain, from the 40 villages represented in the analyses of C01, C06 and C07 sub projects.

Another Master Thesis has been completed in this subproject. Ms. Rakhma Sujarwo wrote about the choice of market channels. Currently possible publication options are considered.

The PhD candidate in this working package has (by the publication of this newsletter) submitted his dissertation.

C02

TITLE: **Historical and Current Patterns of Cultural Landscape Transformation in Jambi Province**

TEAM: Principle Investigators: Heiko Faust, Christoph Dittrich (UGoe); Endriatmo Soetarto, Soeryo Adiwibowo (IPB); Rosyani (UNJA)
Scientific staff: Barbara Beckert, Jonas Hein, Yvonne Kunz, Rina Mardiana (PhD students)
Associated: Lutfi Izhar (Ministry of Forestry Jambi)

PROGRESS / CURRENT STATUS

The research on aspects determining the cultural landscape transformation has been completed. Historical drivers of land use change have been identified and the impacts of the present political framework on the village, province and nation level have been analyzed. Furthermore, the effects of transnational governance arrangements (REDD+) for mitigating climate change on access and property relations were investigated.

Human environment relations need to be seen in their historic and institutional context. Landscape transformation is driven by a complex network of rules and actors and is open to various interpretations and actions. Multiple, unreconciled layers of land tenure regulation and the various ways in which local actors respond to them favor a rapid exploitation and thus transformation of landscapes. Long-term consequences of overlapping, conflicting land regulations remain, creating uncertainty and the tendency of local actors to dynamically negotiate rules leading to ambivalent natural resource management approaches.

Jambi Province is characterized by a rapid and far reaching transformation process, resulting in a fragmented and overlapping

mosaic of resource governance and territorial control. This transformation process is fostered and accelerated by newly emerging social and environmental relations. At the heart of today´s land contestations are access and property relations. Access to land is subject to contestations and struggles resulting from competing and ambivalent institutional regimes and power asymmetries. This has direct effects on peoples´ agency to respond to changes in the politi-

co-legal and social framework. Local actors often engage with discourses at different scales in order to enhance their agency.
Local land conflicts are increasingly influenced by transnational governance arrangements (REDD+) for mitigating climate change. The emergence of REDD+ leads to a new transnational scale of forest governance altering dialectical relationships between structure and agency. The international negotiations within the UNFCCC on REDD+ provide new voice for peasant farmers (e. g. protests and climate change conferences) and at least theoretically new legal opportunities (e. g. Cancun Safeguards) for defending their rights to land and other natural resources. Positions within scales and within scalar networks of power, in particular access to specific political authorities that have the legitimacy to assign property rights (such as Batin Sembilan elites, village heads and the Ministry of Forestry) are important explanatory factors for accessing land and property in the landscapes within and around the Harapan Rainforest project.

C03

Picture: Rosyani and Stefanie Steinebach conduct an interview with Batin Sembilan. (©Matthias Ditscherlein)

TITLE: **Cultural diversity and culture-specific interactions with tropical lowland rainforests in transformation**

TEAM: Principle Investigators: Brigitta Hauser-Schäublin (UGoe); Rosyani, Eko Setianto, Ningsih Susanti (UNJA)
Scientific staff: Stefanie Steinebach (Postdoc)

PROGRESS / CURRENT STATUS

This subproject deals with the dynamics and diversity of the rural population in relation to rainforest transformation systems in the Harapan and Bukit Duableas areas of Jambi Province. Fieldwork in the core villages of both regions has been completed.
Results show that in both research regions land has become a scarce and contested resource sought after by various actors. At the same population density in rural Jambi is constantly increasing through to unassisted in-migration closely intertwined with land use change and cash crop economy. Migrants originate from different parts of Sumatra and other Indonesian islands; accordingly the scope of cultural backgrounds of the people living there becomes more and more variegated.
State regulations concerning land use and the modes of cash crop production level cultural difference of land use on the one hand. On the other hand, membership of particular socio-cultural communities, which is practiced through different ways of affiliation and may vary according to contexts and situations, become key elements for access to land and land tenure security. Collective frames such as ethnicity and identity are negotiated amongst groups but are also determined by stately categorizations and global movements (e. g. Agrarian Movement, Indigenous Rights Movement, Human Rights).
Differences in land use and social structures can be found between the Bukit Duabelas and Harapan research regions. These differences have their origin in pre-colonial socio-political organization that until today facilitated different developments of access to land and land use transformation.
Overall the extensive cultivation of boom crops has induced substantial changes in local livelihood strategies, land use systems and perceptions of the environment. People's engagement in new and expanding transformation systems has a "feedback" on distinct cultural practices and human-environment relationships.

C04

TITLE: **Long-Term Land Use, Poverty Dynamics and Emission Trade-Offs in Indonesia**

TEAM: Principle Investigators: Jann Lay, Stephan Klasen (UGoe); Nunung Nuryartono (IPB); Marhawati Mappatoba (UNTAD)
Scientific staff: Katharina Trapp, Rivayani Darmawan, Dewi Nur Asih, Mohammad Iqbal Irfany (PhD students)

PROGRESS / CURRENT STATUS

Boom and bust cycles of cash crops: Cash crops – like cocoa and coffee in Sulawesi and rubber and palm oil in Jambi – usually follow a boom and bust cycle, meaning that initially high yields are followed by low production outputs. We analyze the cocoa production cycle of households in the Lore Lindu region in Central Sulawesi, using our long-term panel data set (2001, 2006, 2013). First results suggest that although cocoa area and yields are still increasing in the survey region, there is a large variation between farmers: While some manage to sustain their cocoa income, others fail to do so, which is mainly due to differing management practices. As cocoa is cultivated by poor smallholders, this has important welfare implications.

Carbon footprint: We analyze the carbon footprint of households in Jambi and Central Sulawesi, using expenditure data of the 2012 and 2013 household surveys in the two regions. Household income is the main driver of emissions, with fuel-light consumption and other energy expenditures being the major contributors. These results are consistent with our findings of the SUSENAS data analysis.

Food security: Considering that many people in rural areas are engaged in agricultural activities for their income and livelihood, any irregularities of climate and weather patterns may threaten smallholder's crop production, income, and human capital investment. These shocks, in turn, affect food security and welfare of vulnerable households. Against this background, we study weather variabilities and its influence on food security in rural areas of Central Sulawesi. Results show that 77 % of the households were in food insecure condition. As predicted, lower variability of rainfall along with education and access to credit alleviate food security in the research area.

Trends in migration and deforestation: The study examines whether population pressure caused by migration has led to deforestation in Indonesia, by exploiting satellite data that tracks the annual deforestation across Indonesia and relating it to the migration rate at the district level.

C06

TITLE: **Farm-level optimization of land use systems in Indonesia under consideration of uncertainty and ecological effects**

TEAM: Principle Investigators: Oliver Mußhoff (UGoe); Yusman Syaukat (IPB); Napitupulu Dompak (UNJA)
Scientific staff: Stefan Moser (PhD student)

PROGRESS / CURRENT STATUS

Palm oil production creates negative externalities, e. g., through intensive fertilizer application. If policy wants to limit externalities, an effective, sustainable and efficient measure seems desirable. Embedded in a framed field experiment in Indonesia, a business simulation game tests ex ante several incentives for reducing the use of fertilizer in palm oil production. These incen-

tives are arranged in the form of different designs, i.e., either a reward or punishment, varying in their magnitude and probability of occurrence but constant in the effect on expected income.
We compare the use of risk-increasing and risk-reducing production inputs with the risk attitude of producers for rubber farmers. Therefore, the Just-Pope production function indicates production inputs' influence on production risk, whereas a Holt-Laury lottery measures the producers' risk attitude in the laboratory. So far, there are only preliminary results.
We contribute to the C-cross sectional paper by explaining decisions towards palm oil production by farmers risk attitude.

Preliminary results

In general, we found that reward incentives are preferable over punishment incentives. Moreover, it depends on the aim of a policy measure whether the reward should be certain or uncertain. If policy-makers desire a significant reduction in fertiliser use, i.e., an effective and sustainable incentive, results suggest using an uncertain reward. However, if policy wishes to reduce fertiliser use at low cost for all stakeholders, i.e., an efficient incentive, results suggest using a certain reward.
Preliminary results indicate that, in rubber farming, production inputs have a significant influence on production risk. Moreover, we found some correlations between the input use and farmers' risk aversions. However, since results are preliminary further analysis needs to be done.

- Results indicate that moderate risk-averse farmers cultivate palm oil more often and also have bigger palm oil plantation than strongly risk-averse and risk-seeking farmers.

C07

TITLE: **Determinants of land use change and impact on household welfare among smallholder farmers**

TEAM: Principle Investigators: Matin Qaim, Stefan Schwarze (UGoe); Hermanto Siregar (IPB); Zaki Fathoni (UNJA)
Scientific staff: Vijesh Krishna (Postdoc), Michael Euler, Jonida Bou Dib (PhD students)

PROGRESS / CURRENT STATUS

The current status of the sub-project involves the analysis of data collected from about 700 farmer households, with a detailed examination of different aspects of oil palm adoption and its socio-economic impacts. Simultaneously, preparations for an additional survey among non-farm households, which is to be carried out in 2015, are initiated. The objective of the new survey is to examine effects of land-use changes on rural employment and other types of spillovers in Jambi Province.
Five research papers are currently being developed. In the first one, the determinants and impacts of land market transactions over a timespan of two decades are modelled (Krishna et al., 2014). In the second one, the patterns of smallholder oil palm expansion and its drivers are analysed by

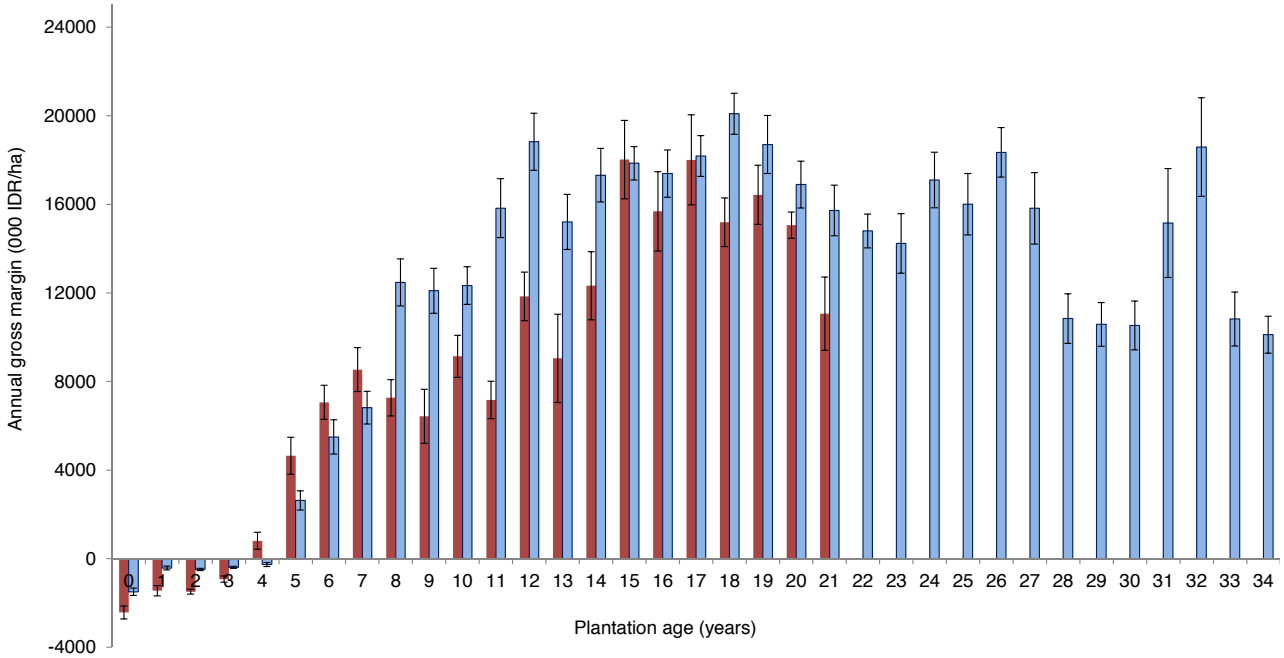


Fig. 15: Annual gross margins for oil palm and rubber plantations over plantation age

employing survival functions (Euler et al., 2015). The third study quantifies smallholder yield gaps in oil palm relative to exploitable yield levels and analyses smallholder production constraints. These three papers are currently under review with different academic journals. Fourth and fifth papers, which examine different farm profitability and livelihood impacts of land use changes in Jambi province, are in the preparatory phase. A comparison of gross margins between oil palm and rubber is shown in Figure 15.

C08

TITLE: **Collective decision making and land allocation at the village level**

TEAM: Principle Investigators: Meike Wollni, Marcela Ibanez (UGoe); Bambang Juanda (IPB); Rosyani (UNJA)
Scientific staff: Marcel Gatto, Miriam Vorlaufer (PhD students)

PROGRESS / CURRENT STATUS

WP 1: Village level determinants of land allocation (Marcel Gatto)

Marcel Gatto has submitted and defended his PhD thesis successfully on February 2nd, 2015.

Prepared manuscripts:

1. Oil palm boom and land-use dynamics in Indonesia: the role of policies and socioeconomic factors (Gatto, Wollni, Qaim) – under review at Land Use Policy and published as EFForTS discussion paper No. 6, 2014
   - Oil palm mostly grown on previous fallow and rubber land, no direct driver of deforestation.
   - But, oil palm growth occurs in locations with ongoing logging activities, so indirect effects on deforestation are possible
   - Transmigration program critical for start and spread of oil palm in Jambi.

– More recently, autochthonous villages slowly starting to cultivate oil palm.

2. Oil palm boom, contract farming, and village development: evidence from Indonesia (Gatto, Wollni, Rosyani, Qaim) – to be submitted and to be published as EFForTS Discussion Paper
   – Positive effect of contract schemes on village wealth (wealth increases with the duration of contractual relationship).
   – Factors influencing investor visit: land availability, proximity to oil mill, secure land rights.
   – Conditional on investor visit, lack of electricity predicts establishment of contract
   – No evidence for exclusion of poorer villages.

3. Trust and market integration: an experimental analysis from rural Indonesia (Gatto, Ibanez, Juanda, Wollni) – in preparation
   – Villages that are vertically integrated into the oil palm sector exhibit higher aggregated trust levels.
   – Generalized trust increases with duration of contractual relationship.
   – No significant difference between contract farmers and non-participants within contract villages.

WP2: Design of incentive mechanisms for sustainable land use (Miriam Vorlaufer)

1. Conservation vs. equity: Can payments for environmental services achieve both? (Vorlaufer, Wollni, Ibanez, Juanda) – in preparation
   – We test an equal PES scheme, where a fixed flat rate per conserved hectare is paid, and a discriminatory PES scheme, which compensates according to the opportunity costs of conservation.
   – Discriminatory PES scheme does not necessarily need to be compromised by lower conservation area at the group level.
   – It furthermore realigns income towards low-endowed farmers and reduces inequality among group members.

2. Disentangling crowding effects in public good provision: A field experiment on payments for environmental services in Indonesia (Vorlaufer, Ibanez, März, Wollni) – in preparation

– We systematically separated the price and crowding effects of PES through two separate treatments.
– Results show that the signalling effect of the PES introduction even works in a non-incentivized context.
– Introduction of PES significantly crowds in conservation behaviour.
– This effect in particular stems from the behavior of non-migrants (compared to migrants), who show lower conservation behavior in the absence of PES.

HIGHLIGHTS GROUP Z02

* Microclimatic data from under the canopy are available for past 1.5 years.
* The success rate of marker matK is lower, but it has higher resolution in species-level identification compared to the marker rbcL.
* About 800.000 –1.000.000 canopy arthropod specimen have been collected using a canopy fogging approach.
* First results indicate that In the Harapan landscape the number of ant species is greatly reduced in Oil Palm and Rubber plantations in comparison to lowland forest. Moreover, the species community varies significantly among different land-use systems.

Z02 Central Scientific Support Unit (CSSU)

TITLE: **Meteo stations**

TEAM: Principle Investigators: Alexander Knohl, Oleg Panferov (UGoe); Tania June (IPB); Heri Junedi (UNJA); Abdul Rauf (UNTA)D, Dodo Gunawan (BMKG)
Scientific staff: Ana Meijide, Andre Ringeler (Postdocs); Edgar Tunsch (Technician)

PROGRESS / CURRENT STATUS

Meteorological stations in the plots will continue running during all 2015, measuring microclimatic conditions under the canopy. A data series from plot data for 1.5 years is already available for any interested groups.
The reference meteorological station from Harapan transformation systems was removed from Pompa Air after some acts of vandalism, and re-installed in Bungku, where it has been successfully measuring since October 2014. A data series from data for 1.5 years is already available for any interested groups.

TITLE: **DNA barcoding of vascular plants**

TEAM: Principle Investigators: Reiner Finkeldey (UGoe); Iskandar Z. Siregar, Ulfaj J Siregar, Utut Widyastuti (IPB); Hamzah (UNTAD); Sri Rahayu (LIPI)
Scientific staff: Fitri Yola Amandita (PhD student)

PROGRESS / CURRENT STATUS

Up to date, 2317 samples have been investigated with rbcL marker and 1810 samples with matK marker.
PCR and sequencing were high with rbcL (97,03% and 91,41%, respectively). matK had only 83,54% of recovery and 65,74% of successful sequencing.
matK has higher success of species-level assignment using BLAST with individual barcodes compares with rbcL. The highest identification match is on genus-level for both markers. Mismatch between morphology identification and molecular identification for both markers are considered low (less than 5%).

Z02 Central Scientific Support Unit (CSSU)

TITLE: **Monitoring aboveground animal biodiversity: canopy arthropods**

TEAM: Principle Investigators: Stefan Scheu (UGoe); Damayanti Buchori, Iskandar Z Siregar (IPB); Bambang Irawan (UNJA); Rosikhon Ubaidilah (LIPI)
Scientific staff: Jochen Drescher (Postdoc)

PROGRESS / CURRENT STATUS

The subproject Z02 (Central Scientific Support Unit) is tasked with sampling canopy arthropods within the EFForTS core plot design and establishing a taxonomic collection in which all specimen are identified to species level. This includes the taxonomic description of new species in close collaboration with Museum Zoologicum Bogoriense at the Indonesian Research Center for Biology, LIPI. Samples have been taken from all 32 EFForTS core plots plus additional sites in permanent research plots of PT REKI in Hutan Harapan. Over the course of sampling in both seasons, an estimated 800.000–1.000.000 specimen have been collected using a canopy fogging approach. The samples from dry season 2015 contained ca. 420.000 specimen belonging to 31 orders. Since July 2014, we were able to assign ca. 45.000 ant specimen to 125 species or morphospecies. First statistical analyses based on ants collected from the Harapan landscape indicate that the number of ant species is greatly reduced in Oil Palm and Rubber plantations in comparison to lowland forest (Fig. 16). Moreover, the species community varies significantly among different land-use systems in the Harapan landscape (Fig. 17). Current and future research activities include photographic documentation, genetic barcoding and stable isotope analysis of ant specimen within an ABS-funding framework at UGOE and the continuation of taxonomic identification and sample handling at IPB.

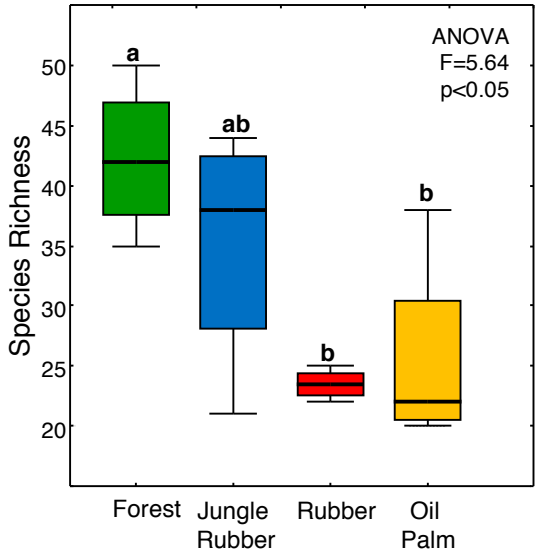


Fig 16: Species Richness in across different land-use systems. Different letters indicate significantly different average species richness (one-way ANOVA, Bonferroni post-hoc, all p<0.05).

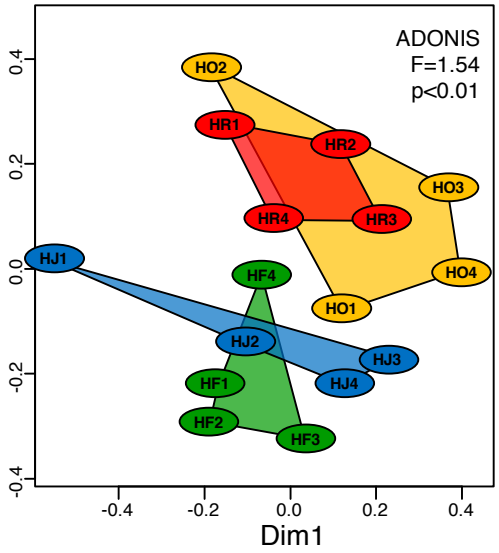


Fig 17: Multidimensional scaling plot based on Bray-Curtis distances of abundance of 99 ant species in 16 plots (4 per land-use system). The ant community in Forest/Jungle Rubber differs significantly from that in Rubber/Oil Palm.

2. Biodiversity research, access to genetic resources and benefit sharing (ABS)

Background

The approval of the Convention on Biological Diversity (CBD) in 1992 was the first step of a new approach to the biodiversity resources and their use, which includes the national sovereignty principle, mutually agreed term and sharing benefits of the use of biodiversity. The *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity, (ABS)* was signed by both Germany and the EU on 23 June 2011, and by the Republic of Indonesia on 8 May 2013 (Law No 11 / 2013).

This new approach is a legal but also a moral commitment which the DFG includes in its institutional policies. For that reason, DFG follows the international regime on ABS and tries to build a bridge between that regime and the scientific community (compare with http://www.dfg.de/formulare/1_021/1_021.pdf).

For the CRC 990 – EFForTS, DFG approved funding of ABS measures with central research funds ("Pauschale Mittel"). Since November 2013 EFForTS provides short-term research grants to counterparts and stakeholders (LIPI, PHKA, BMKG, PTPN VI, PT HUMUSINDO and PT REKI) to strengthen the research cooperation and to complement existing research activities addressing new scientific questions.

So far 32 research projects have been accepted for funding.

RESEARCH PROJECTS OF COUNTERPARTS

Research projects of counterparts funded at IPB

Name	Counterpart	Title
Herdhata Agusta	A02	Soil water dynamics in oil palm and rubber plantations in relation to slope and vegetation cover

To identify the dynamics of water infiltration related to the slope gradient of oil palm and rubber plantations, a double-ring infiltrometer method was applied at plain, slight, medium and heavy gradient slopes. Water infiltration rate in oil palm plantations, especially in the inactive pathway (gawangan mati) is higher than in the active pathway (Pasar pikul). The designed strips in plantations for collecting organic material after periodical harvests and maintenance purposes inhibit water runoff and facilitates more infiltration of water into the soil. Vigorous growth of understory vegetation, due to insufficient weed control, as well as the intensive leaf-litter input from rubber trees in the dry season play a significant role for the dynamics of water infiltration.

Experimental field site at Harapan Rainforest (HR4)

Kukuh Murtilaksono	A04	Dissolved organic carbon in the Bukit Duabelas National Park and the relationship with the soil properties and its toposequence

In forest ecosystems, most of the organic matter supplied to the organic (O) horizon mineralizes to CO_2, but a portion of organic matter is leached as dissolved organic carbon (DOC) as soil water percolates. The DOC transported to the mineral soil horizons may be mineralized, leached or adsorbed onto mineral surfaces. The effect of soil properties on the DOC dynamic has not been fully understood because of limited data. The objective of this research is to characterize the DOC in Bukit Duabelas National Park and reveal the effect of soil properties and the position in the transect on the DOC.

Six soil profiles with different positions in the transect–namely two soil profiles at the top, two soil profiles at the middle of the slope, and two soil profiles at the foot of the slope (near a creek)–were constructed in Bukit Duabelas National Park. The soil samples were collected in the A, AB and Bt horizons. The selected soil properties—namely total C, total N, cation exchange capacity (CEC), soil texture, dithionite-citrate-bicarbonate-extractable iron (Fe) and aluminum (Fed and Ald), oxalate-extractable Fe and Al (Fe_o and Al_o), organically-bound Fe and Al (Fe_p and Al_p)–were analyzed. The soil solutions were collected using tension-free lysimetes beneath the A, AB and Bt horizons. The lysimeters were installed horizontally in small soil pits by inserting the plates (200 cm^2) into precut openings and connecting them with tygon tubing to the collecting bottles. The soil solution samples were collected once per month during one year from the soil profiles and then total carbon in the soil solution was analyzed. However, all soil chemical properties have not been completely analyzed yet. The results show that the position and the horizon of soil profile affected the concentration of DOC. DOC consentration in the A horizon is about 8.5 mg/liter, while the concentrations in the AB and Bt horizons are 2.5 and 1.0 mg/liter, respectively. DOC consentration at the top of slope is about 10.0 mg/liter, while at the middle and foot of the slope they are 12.0 and 16.0 mg/liter.

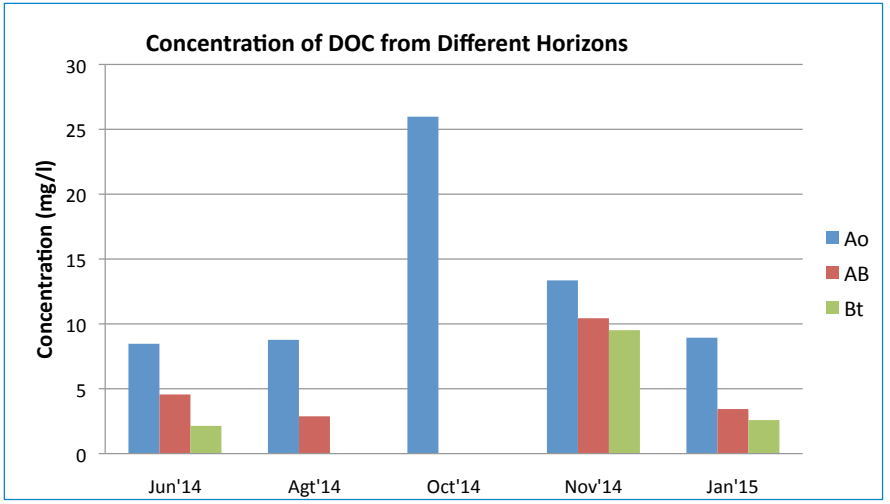


Fig. 18

Lysimeter installed at the soil profile.

Noor Farikhah Haneda	B01	The Role of Ants in Tropical Lowland Rainforest Transformation Ecosystem

Deforestation strongly alters ecosystems and the species composition within these ecosystems. Insects, especially ants, are a particularly interesting taxonomic group to study in deforested ecosystems. This study was conducted in Bungku village, Bajubang subdistrict, Batanghari Regency, Jambi. Pitfall traps were used to collect ant samples in four ecosystems; namely secondary forest, oil palm plantations, rubber plantations, and jungle rubber. On the whole, the study found 33 genera from 6 subfamilies of ants (Figure). Afterwards, the 33 genera of ants were aggregated into functional groups based on their functional role. This grouping revealed a total of 46% foragers, 36% predators, 3% army ants, 3% scavengers, and 3% others. Camponotus and Pheidole were the dominant genera found in this study. Camponotus had a functional role as general foragers and Pheidole had a role as seed predators, with many others that were omnivorous.

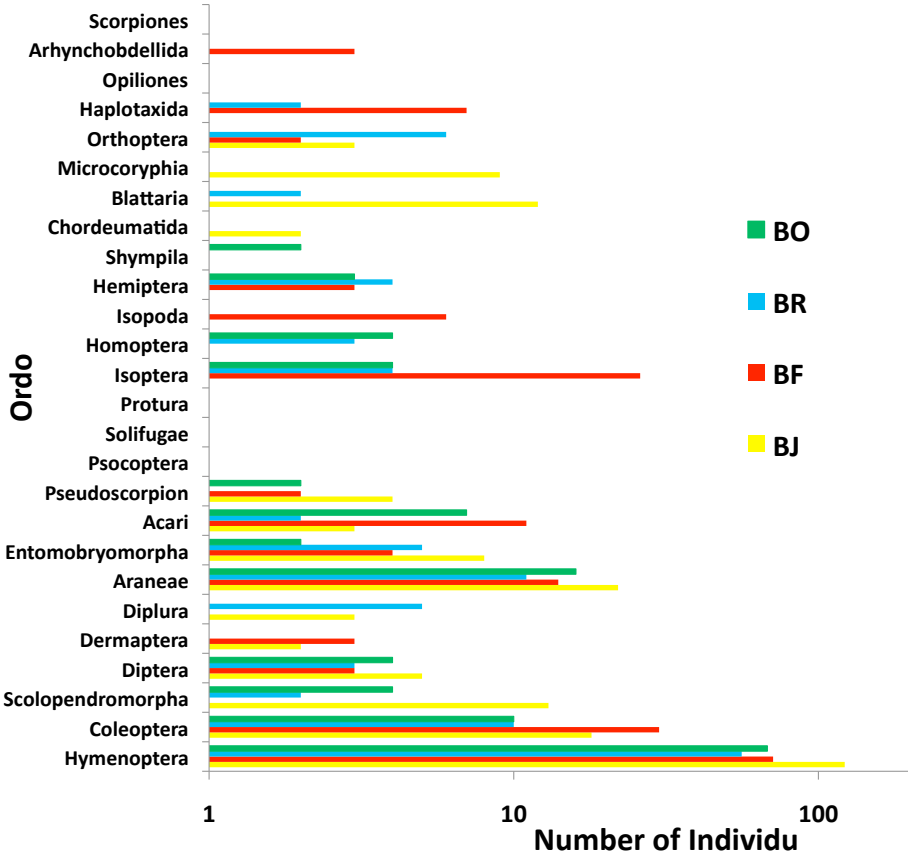


Fig. 19: Diversity of soil fauna

Nisa Rachmania Mubarik	B02	Biodiversity inventory, collection and preservation (in-situ and ex-situ): prokaryotes and leaf blight pathogenic fungi on oil palm

From the first year's results (2013), we have successfully isolated 6 chitinolytic and 13 cellulolytic bacteria from transformation systems (rubber and oil palm plantations) around Taman Nasional Bukit Duabelas Forest. Cellulolytic isolates (*Bacillus cereus* SAHN 13.30 and *Bacillus thuringiensis* KAHN 15.39) and chitinolytic isolates (*Bacillus thuringiensis* SAHA12.08 and *Bacillus cereus* SAHA12.13) were able to inhibit the growth of fungal pathogens such as *Curvularia affinis* and *Colletotrichum gloeosporioide*s by using in-vivo tests. The aims of the research (year 2014) were to select one isolate of *Bacillus thuringiensis* SAHA 12.08 as a model on characterization and partial purification of extracellular chitinase; to determinate its potency as a biocontrol agent of *C. affinis* and *C. gloeosporioides*; and to study the ability of *B. thuringiensis* SAHA 12.08 in inhibiting *C. affinis* and *C. gloeosporoides* through detached leaf assay.

Bacillus thuringiensis SAHA 12.08 showed maximum chitinase with specific activity (7.896 U mg-1 protein) at 60 h incubation. Maximum temperature and pH of chitinase activity were 35 oC and 7.0, respectively. Chitinase was partially purified by 30 % ammonium sulphate precipitation, which could increase 2.35 fold from the specific activity. The activity of ammonium sulphate fractionation of chitinase was optimal at 45 oC and 7.0, respectively. This chitinase was stable at the optimum temperature for 180 minutes incubation. The zymogram analysis revealed that the chitinase had a molecular weight of 82 kDa. In-vitro bioassay through detached leaf assay showed that chitinase of *B. thuringiensis* SAHA 12.08 had antagonistic activity and biocontrol efficacy against *C. afinis and C. gloeosporioides* in oil palm leaves. It was concluded that *B. thuringiensis* SAHA 12.08 is a potent biocontrol agent for *C. affinis and C. gloeosporoides*, which caused anthracnose, leaf blight, and rotting on oil palm leaves.

Dr. Ulfah Siregar	B03	Genetic diversity and evolutionary relationship of Dyera costulata and Dyera lowii in Jambi, Indonesia based on AFLP markers

Dyera costulata and *D. lowii* are endangered indigenous tree species, which grow in two different habitats in Jambi, Indonesia. *D. costulata* grows on hilly areas, while *D. lowii* are usually found in lowland swampy forest. Both trees are intensively harvested by local communities for their latex and wood. Although listed as two different species, local communities often interchangeably use these two species in reforestation programs in the area. This study investigated the genetic diversity of randomly sampled trees of *D. costulata* and *D. lowii* planted in the area using AFLP markers. Two primer combinations, i. e. E-ACC / M-CTA and E-AGG / M-CTC were able to generate AFLP bands. *D. costulata* (He = 0.38) had twice the diversity compared to *D. lowii* (He = 0.19). A dendrogram based on Nei's genetic distance separated the two species; however some costulata accessions showed a closer association with *D. lowii*. The possibility of gradual evolutionary changes from one species to another as the habitat has changed from hilly areas to swampy lowland is discussed.

Triadiati	B04	Contribution of coarse roots and deadwood to soil carbon and total carbon stock in lowland rainforest transformation systems on Jambi, Sumatra

Dead wood and coarse roots have an important role in the ecosystem since they still contain carbon. As they decompose, carbon from both components contributes to the soil carbon. In Jambi, there are different types of lowland rainforest transformation systems; namely rubber, jungle rubber and oil palm plantations. Natural forest has a higher vegetative diversity and abundance than these aforementioned transformation systems. It is assumed that it also has a high diversity and abundance of deadwood and coarse roots. Thus, it is important to analyze the contribution of carbon from deadwood and coarse roots to soil carbon in lowland rainforest transformation systems on Jambi, Sumatra. The research was conducted in the Hutan Harapan, Muara bulian, and Bukit Duabaelas National Park.
Coarse root sampling: Two soil pits per plot will be excavated to 150 cm depth. Soil monoliths with a volume of 30 cm x 30 cm will be extracted. The root material will be separated into five mineral soil horizons: 0-10, 10-30, 30-50, 50-100, and 100-150 cm soil depths. Samples will be washed and sorted into fine and coarse roots. Fine root surface area and diameter will be analysed with WinRhizo (Re´gent, Quebec, Canada). These data will then be used to calculate root area index (RAI).
Dead Wood Sampling: Standing dead trees and fallen dead wood will be recorded within permanent plots.The DBH will be measured on standing dead trees with DBH of at least 10 cm, as well as the height of each standing dead tree using a vertex. Fallen dead wood will be measured that is atleast 1 m in length and 10 cm in diameter. Estimation of deadwood density will be carried out using a Pilodyn meter. Coarse root and deadwood will be analysed for carbon organic content.
So far, results have shown that total RAI in the forest is not significantly different to that in rubber plantations. However, both locations were significantly different to the other two study sites. The amount of fallen deadwood was higher than standing deadwood. The amount of deadwood in forest was higher than in jungle rubber and the amount of deadwood with decay class 1 was higher than that of decay class 2 and 3. Carbon content in coarse roots and deadwood is yet to be analyzed.

I Nengah Surati Jaya	B05	Spatial patterns of forest and land-cover change in Jambi province (Sumatra, Indonesia) from 1990 to 2011

Forest and land cover in Jambi province are quite dynamic, with a significant amount of forest decrement. Transformation of the land in Jambi province has been mainly into plantations to cultivate palm oil, rubber, timber, and smallholder rubber agroforestry. Having knowledge about forest and land-cover change is important for further research to understand the driving factors of land-use and land-cover change; particularly the causes of deforestation and forest degradation. As the intensity and the spatial pattern of land-use change could be different for both study areas considered in the CRC 990 (Bukit Duabelas and Harapan landscapes), this hypothetical dissimilarity may explain some differences between the two considered landscapes, particularly on the factors

affecting the changes. This study examined the spatial patterns and driving factors of land-use change at the landscape level in the study area. The objectives of this project are (1) to study the spatial pattern and fragmentation of land-use change, particularly forest change, in the transformation systems of Harapan and Bukit Duabelas National Park, and to compare it with the general trend for the whole Jambi province in the last 21 years; (2) to produce a time series of LULC maps for the study area, with the forest and land cover classes considered in the transformation systems experimental design of the CRC 990 / EFForTS project: secondary forest, oil palm plantation, intensive rubber plantation and low-intensity rubber (jungle rubber); and (3) to study the effect of land-use change on the aboveground biomass carbon stocks in the study area in the last 21 years. The work performed in this study includes: (1) compilation of both the historical forest and land-cover maps from the Indonesian Ministry of Forestry and time series of Landsat images for each acquisition date; (2) image processing and correction to get a nearly cloud-free mosaic for each acquisition date; (3) visual interpretation of processed Landsat images based on corrected land-cover maps (4) study of the spatial pattern of land-use change; and (5) evaluation of land-use change on carbon stocks. The study found that there is significant land-use and land-cover changes that have occurred since 1990 to 2013 that have typical spatial patterns. From in-depth interviews it was also found that the driving forces of land-use changes are mainly due to the development of estate crops by both local communities and big estate companies.

Sri Wilarso Budi	B07	Diversity of arbuscular mycorrhizal fungi in Bukit Duabelas and Harapan Forest, Jambi Province

The objective of the present study is to determine the diversity of arbuscular mycorrhizal fungi (AMF) in lowland rain forest located in Bukit Duabelas National Park and Harapan rainforest in Jambi Province. Analysis of the number of AMF spores showed that there was variation in four types of ecosystems, both in Bukit Duabelas and Harapan rainforest. The number of spores in the forest ecosystem was lower than in rubber plantations, oil palm plantations and jungle rubber, both in Bukit Duabelas and in Harapan rainforest. The disturbance of ecosystems seems to influence the abundance and distribution of AMF spores. On the contrary, based on the morphology of the spores, the number of different spore types found in the forest ecosystem was higher than in the other ecosystems, both in Bukit Duabelas and in Harapan rainforest. This means that the transformation of land may decrease the diversity of AMF species, but increase the number of spores. Further research is needed to know whether the transformation of ecosystems to rubber or oil palm plantations decreases soil fertility.

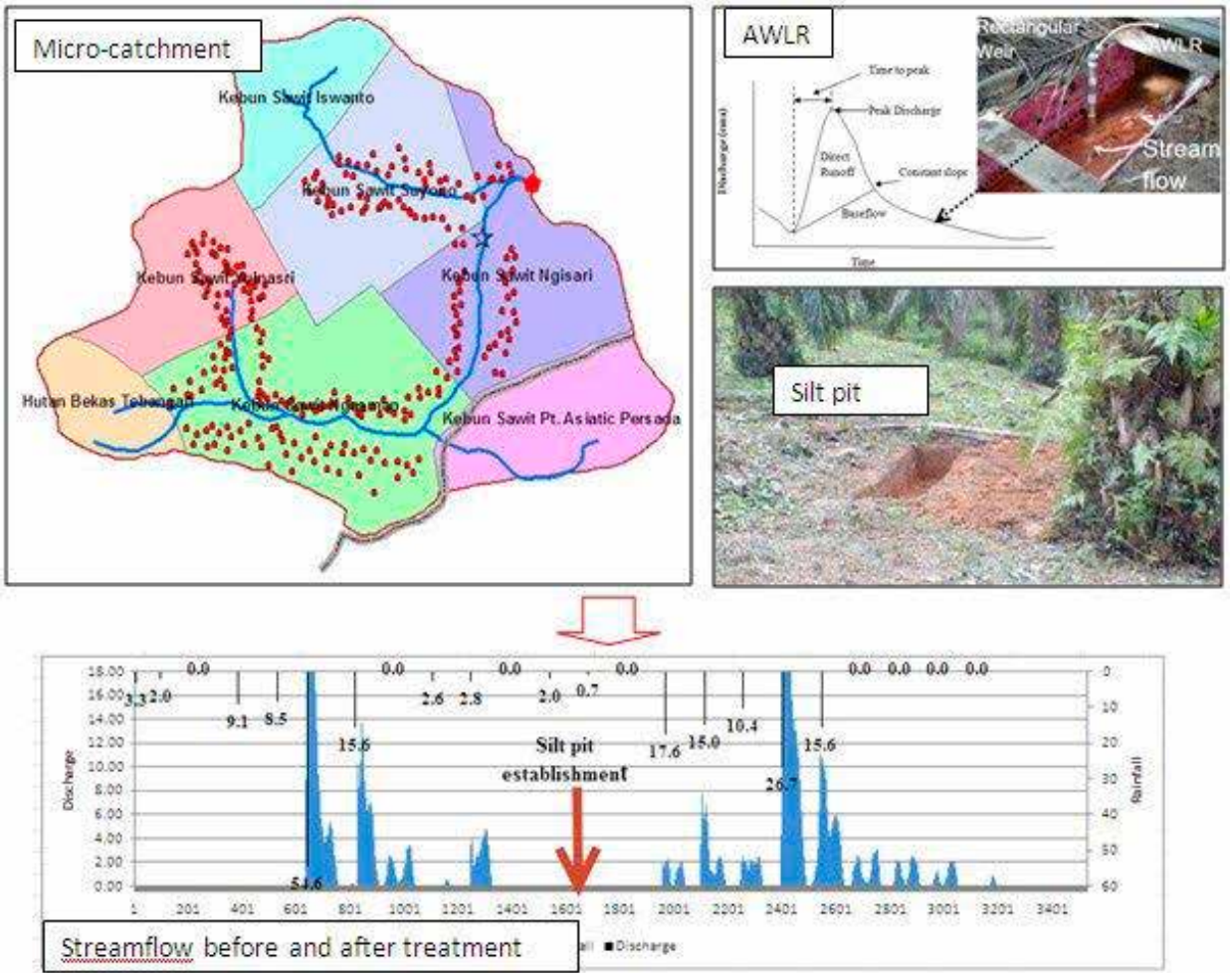
Dr. Rahayu Widyastuti	B08	Seasonal changes of soil microarthropod populations in microhabitats of oil palm plantations of Southern Sumatra

Due to being heavily managed, oil palm plantations are distinctively structured ecosystems featuring low amounts of undergrowth vegetation and thin organic layers, with only small-scale palm frond litter accumulations to provide habitat structure for litter-dwelling soil animals. The soil habitat in oil palm plantations is, therefore, likely to be weakly buffered against seasonal climatic changes. This study investigated variation in soil microarthropod communities and functional properties of the soil habitat (microbial biomass, organic matter, etc.) as affected by seasonal abiotic changes (e.g., precipitation, soil temperature, soil moisture). Additionally the role of microhabitats as refuges for soil animals during climatic extremes was investigated. Four oil palm plantations in the Harapan landscape were investigated. Soil samples were taken every 30 days during a period of 12 months and soil animals were extracted using modified Kempson extractors. Soil microarthopods from various microhabitats (e.g., shaded area, frond litter accumulation, detritus and epiphytes) were sampled once during the wet season and once during the dry season. Abundances of all soil animals were counted, and the Collembola and Oribatida were identified to family level. Preliminary results showed that, generally, abundance and family-level richness of oribatida were lower in open areas than in compost lanes of oil palm plantations, especially during the wet season. Populations of soil microarthropods (Collembola and Oribatida) were more abundant in microhabitats with high litter accumulation, such as stems, fronds and epiphytes compared to the open areas of oil palm plantations. This was more pronounced during climatic extremes, such as in the peak of the wet season. Therefore, enhancement of

soil communities through soil animal enrichment in the open areas of oil palm plantations should be taken into account. Soil animal enrichment can possibly be done through addition of soil-animal-rich soils from the compost lanes into the open areas of oil palm plantations.

Suria DarmaTarigan	B10	Rainforest transformation systems and assessment of their impact on water ecosystem services in Merangin Tembesi Watershed in Jambi

While oil palm expansion in South East Asia continues, the consequences of this rapid expansion for hydrological functioning and other ecosystem functions remain uncertain. Farmers in our study area, the Jambi region of Sumatra (Indonesia), believe that forest conversion to oil palm has reduced streamflow, especially during the dry season. In-depth knowledge on this issue is scarce as there have been only few studies addressing hydrological impacts of oil palm plantations. We investigated hydrological parameters in oil palm plantations, as well as in other prevalent land-use systems: rubber plantations, extensive rubber (jungle rubber), and secondary forest. In oil palm plantations, infiltration was low and surface runoff was high. Nitrate and phosphorous in surface runoff coming from oil palm plots were significantly higher. We used plot results to parameterize a SWAT model to assess the impact of oil palm expansion on water ecosystem services, including water quantity and quality at the watershed level. We found that water yield, baseflow proportion in total streamflow, and nutrient content (nitrate and phosphorous) of rivers were significantly affected when the forest-to-oil palm proportion in the entire watershed was less than 0.7.



Water management in oil palm using silt pit

Ervizal A. M. Zuhud	C03	Ethnobotany of Jelutong *(Dyera spp.)* in Suku Anak Dalam, Jambi

Jelutong (*Dyera spp.*) is an indigenous species of lowland Sumatra and Borneo. It has a lot of valuable benefits for local people, particularly for the "Suku Anak Dalam (SAD)" in Bukit Duabelas National Park, Jambi. However, forests around the national park have been transformed to various land uses, leading to jelutong habitat degradation. Under such conditions, the SAD may have various coping strategies in order to take full benefits of the remaining jelutong trees. The main objective of this research was to understand the local ecological knowledge of the SAD, including the complex relationships of jelutong conservation in Jambi by using the following methods: i) interviewing 30 SAD respondents to identify ethnobotanical aspects of jelutong, ii) analysing the local vegetation to identify the potential of jelutong found in various types of land cover and associated plant species diversity, and iii) studying and reviewing the relevant literature. Preliminary results showed that jelutong trees were not tapped anymore by the SAD in the studied site because the middle man of jelutong latex had died and no one was continuing the market chain due to a low selling-price of the latex. In addition, the local government has not been present yet to empower the local people in conservation and sustainable uses of jelutong. Instead, the local people prefer to cultivate rubber and oil palm, due to higher opportunity costs and benefits. Vegetation analysis showed that jelutong trees were found to be randomly distributed, with 3 – 8 individuals per ha in which their diameters varied between 10 to 51 cm in size. There were 46 species of edible/food plants and 64 species of medicinal plants found in the sampling plots. This baseline information may be further explored to support the formulation of appropriate strategies for conservation actions of jelutong.

Nunung Nuryartono	C04	Consumption pattern of the poor households in Jambi Province

Food is a necessity because it is a basic need for human life. As such, adequate food for every person at any time is a basic human right. In the field of food policy, the problem of food meeting the needs of all residents at all times has become the main target for central and local governments. This study used the data of the National Socio economic Survey (SUSENAS) March 2008-2010 in Jambi. The model of *Linier Approximation- Almost Ideal Demand System* (LA-AIDS) will be used to analyse selected staple food commodities as substitutions or complementary commodities. The objectives of this study are to describe the pattern of food consumption of poor households, identify factors that influence food consumption patterns of poor households, and analyze changes in food consumption of poor households due to changes in prices, income, and socio-demographic characteristics. Based on preliminary results, patterns of consumption can be found whereby the share of food expenditure in poor households is still high, at around 72 percent in 2008, and slightly lower (71 percent) in 2010. Analysis by region shows that in rural areas, share of food expenditure is higher compared to urban areas; 81.39 percent in rural areas, compared with 75.99 percent in urban areas (2008). One of the important implications of high food consumption of the poor is the government's attention to the need for food. In addition, the phenomenon of volatility in food prices should be a concern.

Research projects of counterparts funded at UNJA

Prof. Asmadi Saad	A01	Tropical modern pollen collection as a tool to interpret the quarternary fossil pollen records in Sumatra, Indonesia

Collections of modern pollen samples represent the basic research tool of any palynological research. Without proper surveys of the modern pollen assemblage of the area under study, the analysis is often, if not always, incomplete. Despite this, Indonesia currently lacks such a collection. Only a small pollen collection of about 200 pollen and spore taxa can be found at the Herbarium Bogoriense (Bogor, Java), while the rest of Indonesia, including UNJA, has never had the opportunity to create a modern reference collection for pollen and spores. The reason for this is mostly related to the fact that Indonesian universities lack the necessary facilities and equipment needed to implement pollen analysis. In

Asmadi Saad (right) and his team in the field taking soil cores.

Jambi, following the collaboration established between the Department of Palynology and Climate Dynamics in Goettingen and UNJA (EFForTS-A01), this is no longer a problem. Since the end of 2013, a new fully equipped laboratory for pollen analysis is ready to be used. As a consequence, until now palaeoecological and palynological studies have very rarely included detailed analysis on pollen rain in the area under study. The present proposal will make such indispensable information available for the province of Jambi, and will be the first complete pollen rain-vegetation study in Indonesia. Therefore, the proposed research would be an important step forward in the advancement of palynological analysis in Sumatra and Indonesia. Objectives of this research are to (1) develop a pollen and spore collection at UNJA and (2) carry out vegetation analysis and set new pollen-spore traps in defined locations related to the A01 subproject (Jambi province). The project area spans the whole Jambi province, from mountainous regions to the coastal peat forests via inland lowland rainforests. The target locations are where natural vegetation is mostly preserved and protected. The selected locations are Taman Nasional Kerinci Seblat (TNKS), Taman Nasional Berbak (TNB) and Peatland Conservation areas Sungai Buluh. Proposed methods include vegetation surveys, flower collection, pollen traps and pollen analysis. Research will be carried out during flower blooming from December 2014 until June 2015 to collect the flowers and pollen traps. Mountainous areas dominated by family Dipterocarpaceae (*Shorea Spp, S. teysmanniana and S. pinanga, Dipterocarpus appendiculatus, Anisoptera* spp., *Hopea* spp., and family Sapotaceae (*Castanopsis buruana, Ixonanthes petiolaris, Calophyllum inophyllum, Mangifera minor, Santiria laevigata, Diospyros macrophylla* and *Alseodaphne umbeliflora*. The low-land area was dominated by family Apocynaceae (*Dyera polyphylla*), Anacardiaceae (*Gluta renghas* L.,), Sapotaceae (*Palaquium obovatum*), Arecaceae (*Calamus javensis* Blume), Pandanaceae (*Pandanus spp*), and Ebenaceae (*Diospyros glaberrima* Koenig).

Damris Muhammad	A04	UV and FTIR characterization of dissolved organic carbon in soil extracts and leachates from tropical lowland rainforest transformation systems

The properties of dissolved organic carbon (DOC) are diverse and complex in nature with varying structural, functional and molecular weights. Tropical lowland rainforest transformation may lead to major modifications of soil properties, including DOC, in the forest floor. The aim of this study was to characterize spectroscopic properties of DOC from the soil using hot and cold water as extraction agents. The spectroscopic properties were determined by a combination of spectroscopic techniques (UV-Vis and FTIR). Soil samples were collected from the forest transformation systems of Bukit Duabelas National Park from 0-10, 10-20 and 20-30 cm soil depths with three replicates. Dissolved organic carbon was extracted from the soil using a soil-water ratio of 1:5. The suspension was agitated for 15 minutes and the supernatant was filtered through 0.45 µm cellulose membrane following centrifugation and immediately analyzed. Fractions of the supernatant were used for a 15-day incubation study and analyzed at day 1, 5, 10 and 15. The total DOC in top soil (0-10 cm) of natural forest (378 µg C/g soil) was slightly higher than the rubber plantation (370 µg C/g soil) and jungle

rubber (375 µg C/g soil), but considerably higher than in the oil palm plantation (304 µg C/g soil). Depth profiles of total DOC decreased following the soil depth of each forest transformation systems. Hot water extractable DOC was slightly higher than cold water. A UV Spectrum of DOC showed a sharp peak at 235 nm and indicated the presence of aromatic hydrocarbon. Incubation up to 15 days decreased the UV peak gradually. This probably indicates that the majority of DOC has been converted into a gaseous phase and released into the atmosphere in the form of CO_2. However, hot and cold water extracts showed variation in response to incubation, probably indicating different characteristics of DOC in the extracts. We need more lab works on spectroscopic properties of DOC to gather FTIR data analysis.

Bambang Irawan	B03	Flowering and fruiting ecology of ironwood (*Eusideroxylon zwageri* Teijsm. & Binn.)

Bulian/ulin/belian/borneo ironwood (*Eusideroxylon zwageri* Teijsm. & Binn.) belongs to the family of Lauraceae. *E. zwageri* is one of the most important construction woods in Indonesia. The most valuable characteristic of *E. zwageri* is that it is not vulnerable to termites and other ubiquitous tropical wood-eating insects and fungi. The growth of ironwood is slow in comparison to other tree species. In most tropical trees, flowering is episodic and seasonal peaks of flowering have been recorded for many tropical trees. Knowledge of the flowering ecology of *E. zwageri* is limited or close to absent at present. In fact, this information is very important for the management of *E. zwageri* regeneration. The study on the flowering and fruiting ecology of *E. zwageri* has been conducted (1) to investigate the relationship between climatic and edaphic factors influencing the flowering of *E. zwageri* and (2) to study the flowering and Fruiting phenology of *E. zwageri*. The study has been conducted in four locations; namely (1) Durian Luncuk Conservation Area, (2) Senami Forest, (3) Bungku, and (4) Sridadi Village. Purposive sampling has been applied. The size of the plots was one hectare, both in Durian Luncuk and in Senami Forest. The mature trees inside the plots were observed regularly, once every two weeks. Two flowering trees growing in Bungku and Sridadi were observed regularly to obtain data on flowering and fruiting phenology. Growth rate and morphological characteristics of the shoots and the leaves were also recorded once every two weeks. The results showed that the mean DBH of flowering trees in the Senami Forest was 20.14 cm, while in the Durian Luncuk the mean DBH was 39.55 cm. Additionally, the percentage of flowering trees in Durian Luncuk was slightly higher (59.79 %) compared to those in Senami Forest (51.90 %). The inflorescence reached maximum growth in eight weeks, which could be explained by the equation of $Y = 0.112x2 + 2.128x - 1.825$ ($R^2 = 0.983$). Alternatively, fruit length and diameter reached maximum growth 18 weeks after pollination, following the equations $Y = 5.763 \ln x - 1.83$ ($R^2 = 0.95$) and $Y = 2.544 \ln x - 1.199$ ($R^2 = 0.27$), respectively. Fruit shedding occurred at 30 weeks after pollination. Leaf length and width reached maximum growth eight weeks after initiation, following the equation of $Y = 0.368x2 + 7.003x - 5.229$ ($R^2 = 0.945$) and $Y = 0.167x2 + 3.213x - 2.926$ ($R^2 = 0.950$) respectively. There was no leaf shedding up to 30 weeks of observation. Finally, the twig length development followed the linear equation $Y = 2.433x - 4.096$ ($R^2 = 0.947$).

Revis Asra	B06	Diversity of dragon's blood palm (*Daemonorops spp.*) in Bukit Duabelas National Park, Sumatra, Indonesia

Bukit Duabelas National Park is one of the habitats for jernang rattan (*Daemonorops spp.*). It is one of high economic value. It has red rubber (resin), so this rattan is also called Dragon's Blood Palm. The Anak Dalam Tribe usually use its fruit. They extract the fruits to take the red resin, and then they sell it to local buyers. The red resin can be used as medicine and natural colour. The concept and objectives of this research were to identify the species of Dragon's Blood Palm (*Daemonorops spp.*) in Bukit Duabelas National Park, the number of clumps per plot, number of individuals per clump, and the growth rate in each clump. This study used survey methods and data collection was carried out using purposive random sampling. Sampling was carried out in the four forest core plots of the CRC (BF1, BF2 BF3 and BF4). Each plot had a size of 10 x 10 m. From the CRC plots, 100 subplots were sampled. Sampling will also be conducted outside of the CRC plots. About 20 of the plots were on drained land. Based on field observations, specifically in the BF1, BF2, BF3, and BF4 CRC plots, there were no *Daemonorops* species found. Interviews with rangers in Bukit Duabelas National Park at Dusun

Baru Resort and Pematang Kabau Resort indicated that all varieties of rattan were kept away from the construction of CRC Plot. Survey result showed that *Daemonorops spp.* were found in Demplot Jernang location in Bukit Duabelas National Park area. The location of Demplot Rotan Jernang is the protected habitat of Dragon's blood palm in Bukit Duabelas National Park. The only species found in the Demplot area was *Daemonorops draco*, and only one clump of *D. draco* was found with a total of 15 individuals per clump. The sex of these individuals was female, which was identified from the fruit of the plant. The Level of Growth analysis of *D. draco* showed that the individuals were: three individuals of the 'youngest' class, five 'young' individuals, two mature individuals, and two 'aged' individuals.

Revis Asra (right) and field guide (left) in front of a *Daemonorops spp* demplot in Bukit Duabelas National Park.

Wilyus	B08	Potential of entomopathogenic fungi in rainforest transformation systems In Jambi Province

This research was carried out to know the potential of entomopathogenic fungi in various rainforest transformation systems in Jambi Province. The research was carried out using explorative methods. Exploration sites were located in two landscapes (Bukit Duabelas National Park and Harapan Rainforest regions), consisting of 16 sampling sites in each landscape. Thus, in total there were 32 sampling sites that were situated close to each of the plots of the CRC 990 study sites. Exploration of entomopathogenic fungi was carried out by collecting insects that were infected by fungi, and by biting of entomopathogenic fungi from soil using *Tenebrio molitor* 3–4 instar larva. Sampled entomopathogenic fungi were cultured in GYA (glucose yeast agar) media, isolated and identified at the Pest Protection Laboratory and Agribisnis Laboratory at University of Jambi. Data were analyzed descriptively by displaying in tabulated form with images describing the morphological characteristics of the conidia and mycelia of each species. Results showed that there were six genera of entomopatogenic fungi found at the research sites. These were namely *Metarhizium*, *Beauveria*, *Verticillium*, *Nomureae*, *Paecilomyces*, and *Sorosporella*. All of the fungi have potential for the development of biological control.

Sunarti	B10	The Distribution of soil organic carbon and its relevance for soil water content in oil palm plantations

Expansion of oil palm plantations is assumed to be responsible for degradation of hydrological functions. The objectives of this research were to identify the distribution of soil organic carbon and water content, and to evaluate their relationship at several soil depths across an age gradient of oil palm. The research activities included a field survey and laboratory analysis. The field survey was carried out for identification of the oil palm age gradient and soil samplings. The research was conducted in smallholder oil palm plantations at Bungku Village, Batanghari District, Jambi Province in February – June 2014. Soil samples were collected from several ages of oil palm plantations (0, 1, 5, 7, 10, and 16 years) from 0–30, 31–60, and 61–90 cm of soil depth, with three replicates, respectively. Laboratory analysis was conducted to determine soil texture, bulk density, organic carbon and water content. Data of soil properties was analyzed descriptively and, furthermore, the relationship between soil organic carbon and soil water content under different soil depths along an oil palm age gradient was analyzed by regression analysis. The smallholder oil palm farmers at Bungku Village managed their plantations with outdated technology, and oil palms were grown mostly unweeded. Results indicated that soil in different ages of oil palm plantations was differently compacted. Soil bulk density was 1.12–1.59 g cm^{-3}

and soil organic carbon (SOC) is very low-low (0.29–1.60 %). The relationship between soil depth and SOC across the age gradient of oil palm plantations was linear. The deeper the soil depth, the lower the SOC was. Low SOC was responsible for low soil water availability in oil palm plantations. Meanwhile, the relationship of SOC with soil water content (field capacity, permanent wilting point, and available water) in different ages of oil palm plantations was not always linear. The difference in water consumption across the age gradient of oil palm plantations, along with other factors, were presumed to have an influence on soil water content in oil palm plantations, simultaneously. We need more comprehensive research on hydrological functions of soil in different ages of oil palm plantations, determining factors, and autocorrelation of determining factors.

Rosyani	C03	Suku Anak Dalam (SAD) communities, their institutional transformations and their impacts on environmental changes around the National Park Bukit Duabelas (TNBD)

The Police of Government in Jambi Province has resettled the SAD, who once lived semi-nomadically inside the forest. The SAD live in Pematang Kabau village; one group resides at Jl. Singosari / KOPSAD and the other at Jl. Kutai Ujung. The locations are around one kilometer from TNBD. Each location is held by the "Temenggung" who serves as a political authority or customary leader.

This research will try to answer these questions: what impact does the SAD resettlement have on the immediate neighbourhood of transmigrant communities, and how are their environmental interactions with their oil palm plantations. On the other hand, this research clarifies how economic and ecological changes influence the SAD life and their value systems in general.

Institutional transformation has occurred as the SAD have become settled/sedentary, which will be followed by the transformation of their environmental values. The changes in land-use perception and institutional paradigms will have further consequences for the lives of the SAD.

The research methods include the Focus Group Discussion (FGD) approach and direct interviews with SAD groups who live in Kutai and Singosari streets. Descriptive analysis is applied by using the "Delphi Method Analysis". The sources of the data are primary and secondary data. Primary data is directly collected from SAD community informants using in-depth interviews and participant observation methods during the fieldwork. Literature (journals, books) and unpublished reports are used as secondary data.

The impact of economic changes is seen from the activities carried out by the SAD to support their life. There are 27 household resettlements in the Singosari area; 55.55 % of SAD activities are made up of planting and harvesting rubber inside the area of the BukitDuabelas National Park. 25.93 % of the SAD are working for the oil palm plantation company. The other 18.52 % work as farmers in the oil palm plantation on the boundary area of the Bukit Duabelas National Park. In the Kutai area, there are 44 SAD; 77.27 % of SAD activities are made up of planting and harvesting rubber inside the area of the Bukit Duabelas National Park, and 22.73 % work as farmers in the oil palm plantation of the boundary area at the Bukit Duabelas National Park. Although the government assistance is not sufficient to fulfil their needs, the SAD still have opportunities to earn income from the Bukit Dua-

belas National Park. It is a positive thought to locate the resettlement adjacent to the National Park.
Social activities, such as education, are considered substantial for the SAD. 90.14 % of SAD mentioned that they need education for their families and want their children to go to school. 9.86 % of SAD did not give their answers. Education for SAD children is held twice a week. Some SAD families go to elementary school in Pematang Kabau Village. The adat is still running together with the governmental regulations.
Environmental impact on the SAD is shown by the changes in their perception, as they are not only dependent on the forests but also plant oil palm on their land. They own the house but not the land. They have orchards around the housing but there are no activities that utilise them. Another environmental impact is poor quality of water from the river around their houses. This happens because of the use of detergent and disposal of domestic waste into the river.
Environmental problems still exist because the SAD have not been able to fully adapt to the new environment. In addition, the health department has not fully empowered the SAD regarding environmental health.

Research projects of counterparts funded at UNTAD and Universitas Brawijaya

Aiyen Tjoa / Sri Rahayu Utami	A05	Field decomposition of pruned oil palm frond and its nutrients release pattern

The analysis of litter quality and quantity and its rate of decomposition are important for the understanding of nutrient cycling to support plant productivity and its sustainability. Decomposition is a key process in the control of nutrient cycling and formation of soil organic matter. Decomposition of leaf litter is also an integral and significant part of biochemical nutrient cycling and food webs; this refers to both the physical and chemical breakdown of litter and the mineralization of nutrients. Plant production depends on the recycling of nutrients within the system; recycling depends on the rate of decomposition of organic matter and the release pattern of nutrients. However, although many studies have examined the potential of litter decomposition to transfer back the nutrients to plants, very little is known about the rate of oil palm frond decomposition and its nutrient content. This study, therefore, focuses on the amount of nutrient contents in pruned and decomposed frond of oil palm and its rate of decomposition. This study will be conducted in four oil palm plots of the CRC 990 research project located in Jambi Province. A litterbag technique is used to study the pattern and rate of litter decomposition and nutrient release of pruned oil palm frond. 192 litter bags will be distributed equally to four plots. 16 litter bags will be retrieved randomly from the plots at 1 month intervals for 12 months. Nutrient concentration such as C, N, P, Mg, Ca, K, Fe, Zn, Mn and Ni in decomposed oil palm frond will be examined.

Litterbag experiment with pruned oil palm fronds.

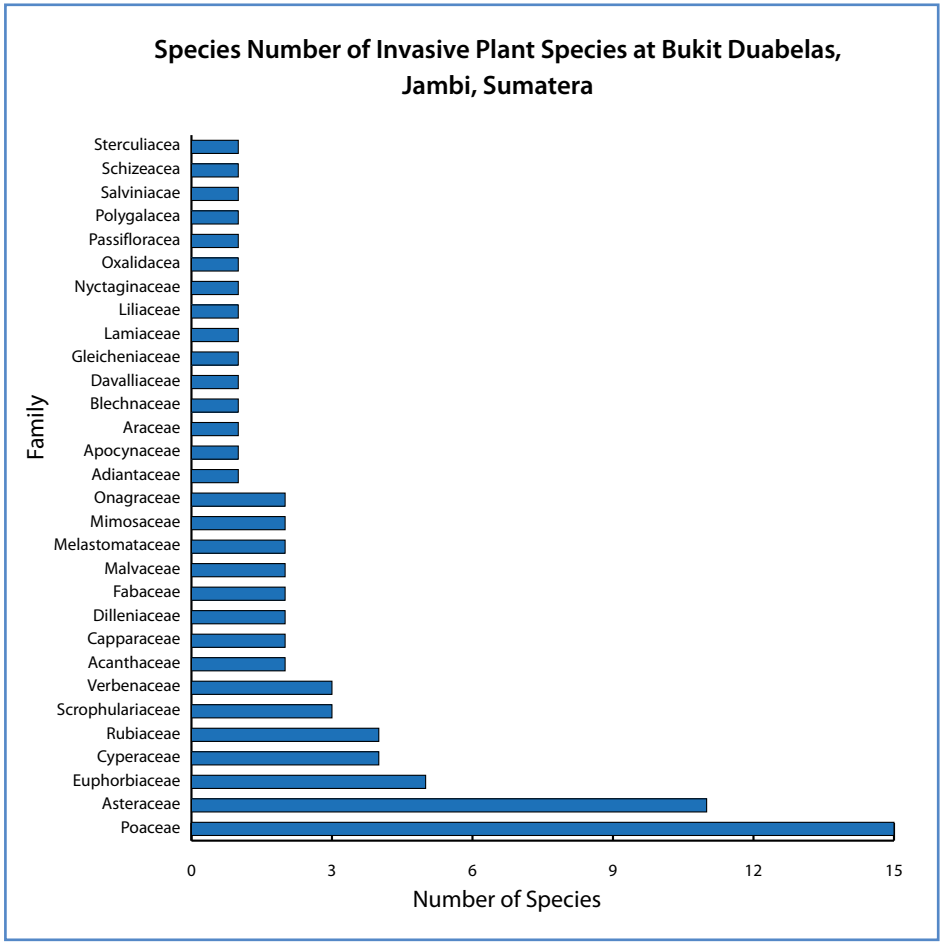
Research projects of counterparts funded at LIPI

Sri Rahayu	B03/ Z02	Genetic diversity and DNA barcode-based identification of Hoya (Apocynaceae:Asclepiadoideae) in different transformation systems in Jambi

Hoya species diversity in Jambi can be utilized by the local people as a new economic source (i. e., promoting it as an ornamental plant that can be exported overseas), in addition to research and development for future biomedicines. The information on hoya species and genetic diversity in Jambi is still very limited. Knowledge of the degree of impact of habitat changes to the species and genetic diversity of hoya in Jambi is lacking and is urgently needed to formulate appropriate conservation strategies and sustainable utilization of the species. Hoya species diversity has been assessed by field surveys at four different transformation systems: i. e., forest, jungle rubber, rubber plantations and oil palm plantations in the three locations Bukit Duabelas, Bukit Harapan and Bukit Sari in Jambi. We collected 58 total specimens from about 9 species of hoya and 2 species of *Dischidia*, which were mainly found in the forest. There was only one individual sample of *Dischidia cf. imbricata*, which was found in a jungle rubber plantation in Bukit Sari. There were species differences between locations, while only a single species, *Hoya cf. revolute*, was found in all locations. Most samples found were sterile, so identification was not clear yet. Only one species found was fertile and easily identified as *Hoya rintzii*. We are investigating the genetic diversity using microsatellite markers, as well as developing DNA barcode-based identification using rbcL and matK markers.

Sri S. Tjitrosoedirdjo	B06	Distribution of invasive alien plant species and recommendation for management action at Bukit Duabelas, Jambi, Sumatra

Bukit Duabelas National Park is one of the remaining forests in Sumatra, which has to be conserved. Conversion of the surrounding areas into rubber and oil palm plantations might facilitate the invasion of IAPS (Invasive Alien Plant Species) into the forest. This research is a continuation of the previous work funded by Start-up project CRC 990. The aims of the study are: 1) to gather a list of IAPS at Bukit Duabelas, Jambi and their surrounding areas, 2) to determine their distribution in each of the ecosystem types of natural forest, jungle rubber, rubber plantation, oil palm plantation and residential areas, 3) to prioritize the management of IAPS invasions based on the level it causes using risk analysis. Field work was carried out in June 3 – 13, 2014. Exploration and sample collections were



carried out at the permanent plots and their surrounding areas. Spatial distribution analysis was conducted by creating vegetation profile diagrams horizontally on the permanent plots. A scoring system of risk analysis was also conducted based on the IAPS protocol of risk management as proposed by Tjitrosoedirdjo et al (2013) (modified from Virtue (2008)). Observation within the natural forest showed that there was no IAPS found inside plots BF3 & BF4, 12 species in the jungle rubber (BJ4 & BJ5), 16 species in the rubber plantations (BR3 & BR4), and 23 species in the oil palm plantations (BO2 & BO4). Although there was no IAPS found inside the plots in the forest, there were 24 species found outside the forest, 44 species found outside of the jungle rubbers, 16 species outside of the rubber plantations, 16 species outside the oil palm plantations and 45 species in the residential areas. A horizontal vegetation profile diagram of the BJ5 plot showed that *Dicranopteris linearis* has the highest coverage (639.977 m^2) followed by *Clidemia hirta* (140,877 m^2). The spatial distribution patterns of IAPS will be overlain with spatial data of canopy openness using ARCView 3.3 program to observe the relationship between their distribution and light intensity. The horizontal vegetation profile diagrams and spatial distribution analyses of the other plots are still in progress. *Clidemia hirta*, an important IAPS, was valued at 4 for the risk analysis and received a feasibility factor of 8, which can be interpreted as 'medium' in the range of important IAPS. Analyses of other species will follow.

PT Restorasi Ekosistem Indonesia

Research projects of stakeholders funded at PT REKI

Luce	B04/B08	Nutrient input and decomposition in high and low quality lowland secondary tropical rain forests

Studying the nutrient cycle is necessary to determine the amount of organic matter and nutrients available in the soil. Litter fall and the decomposition of organic matter are primary aspects of nutrient cycling and it is well known that both may vary according to the stage of secondary succession. The research was conducted in the HRF, Batang Hari Regency, Jambi province. The research was in collaboration with CRC990 (EFForTS) University of Gottingen, Germany. The study sites were selected in lowland secondary forest, within the HRF, Sumatera.

Litter traps were installed in paired (close proximity) high and low secondary forest sites, replicated six times. Litter fall, decomposition and organic matter samples were conducted by sampling every month for a 1 year period. Decomposition was measured at the location of each litter trap.

Preliminary results show that the total soil organic carbon in top soil (0-5 cm) in high secondary forest (5.78 %) was about 27.51 % higher than in low secondary forest (4.19 %). Total organic carbon decreased with increasing soil depth in each forest type. Total N in high secondary forest (0.39 %) was higher than in low secondary forest (0.30 %). The highest Ca was 38.14 cmol/kg of soil, which was found in the top soil in high secondary forest. The lowest Ca was 3.50 cmol/kg was also found in high secondary forest but at 60–80 cm depth. The soil nutrient content data will be used to determine the suitability of land and the suitability of plants, given the soil nutrient content.

The mean litter fall production during the first quarter for high secondary forest was 87.96 g/m^2, and 61.41 g/m^2 for low secondary forest. Litter fall production was higher in high secondary forest than in low secondary forest, by about 18.15 %. Nutrient content of litter fall in high secondary forest was similar to low secondary forest. Analysed components of plant tissue (such as cellulose, hemicellulose, lignin and tannin) along with their values for high

and low secondary forest, respectively, are as follows: cellulose 27.27 %, 26.98 %; hemicellulose 17.54 %, 18.20 %; lignin 51.77 %, 50.35 %; tannin 1.80 %, 2.56 %).

Research projects of stakeholders funded at the Ministry of Forestry

Lutfi Izhar	C02	Forest Community Plantation as Alternative Conflict Resolution of PT. REKI Concession in Jambi Province

Acute forest-tenure conflicts in forest areas are increasing. Permits for use of forest areas seem to be a trigger of conflict between communities and concessionaires. Consortium and ownership have been used as legal ways to obtain forest utilization licenses from the government. People with limited capital claim have been already living in and cultivating forest areas for their living before concessionaires acquired legal permits. Each of them try to defend their right to forest areas. The objective of the research is to identify the encroachment group and to study the implementation effectivity in forest partnership as a means of conflict resolution in concession areas of PT. REKI. This research employs literature, survey and field studies to obtain data and information related to the implementation of government policy and conflict resolution. The data will be analyzed descriptively with studies based on facts in the field, and policy concepts that have been issued by the Ministry of Forestry will be scrutinized. The results indicate that implementing empowerment of local communities through partnerships forestry concept, which is stated in the Ministry of Forestry Regulation No. P.39/Menhut-II/2013, is effective. The partnership pattern of implementation concept can be found in concession areas of PT. REKI, which is between PT. REKI and the Suku Anak Dalam (SAD) group. Specifically, PT. REKI supplies the facilities and tools to SAD that support ecosystem restoration of Hutan Harapan. Based on a number of surveys, it is known that the societal structure in the concession areas can be classified into these categories: 1) the poor worker/labourer; 2) the poor farmers (≤2 Ha); 3) the farmers (≤ 10 ha); 4) farmer businessman/investor (100–200 Ha); 5) out comers with special visiting frequency; 6) the society who informally has the land but lives in out concession of PT. REKI. Both the society groups and PT. REKI still have not found the conflict finishing agreement, which is about forestry partnership. Those parties are still in the negotiation process. The implementation of forestry partnership as a means of conflict resolution in the PT. REKI concession needs to be encouraged, along with serious actions from all parties, to achieve the best conflict resolution.

Research projects of associated PhD students

Fitri Yola Amandita	Z02	DNA barcoding of vascular plants

DNA barcoding aims at providing a fast, accurate, and easily accessible species identification system. The use of DNA barcoding is of particular relevance for the identification of plants in highly diverse but endangered tropical systems, such as in the forests of Indonesia which are facing great threats. This research takes place in Jambi Province (Sumatra, Indonesia), where most of the original forest cover has been converted into oil palm and rubber plantations. We aim to sequence the DNA barcodes of vascular plant species in logged-over old growth forest and in three different transformation systems (jungle rubber, rubber and oil palm plantations). We then aim to combine this with classic morphological species identification to establish a barcoding system for vascular plants in the region, and to make the data available for the scientific community via DNA barcoding databases. Together with specimen data and high quality photographs of fresh and dried plant material, this information should speed up plant research in tropical transformation systems.

3. New Master studies of the CRC 990 since May 2014

TP	Name	Theses
A01	**Reuter, Katharina**	A study on yearly pollen production and plant phenology in rainforest transformation systems in Sumatra (Indonesia). transformation systems in Sumatra (Indonesia). http://www.uni-goettingen.de/de/a-study-on-yearly-pollen-production-and-plant-phenology-in-rainforest-transformation-systems-in-sumatra-indonesia-katharina-reuter/506893.html
B01	**Jurkschat, Lukas**	Length-mass regression of temperate and tropical invertebrates http://www.uni-goettingen.de/de/length-mass-regression-of-temperate-and-tropical-invertebrates-lucas-jurkschat/487521.html
B09	**Lobite, Neil Jun**	Influence of Tropical Lowland Rainforest Transformation Systems to the Community, Genetic and Trophic Structure of Bats in Jambi, Sumatra http://www.uni-goettingen.de/de/influence-of-tropical-lowland-rainforest-transformation-systems-to-the-community-genetic-and-trophic-structure-of-bats-in-jambi-sumatra-neil-jun-s-lobite/506854.html
B11	**Cordts. Birte**	Diversity in seed rain of oil palm plantation vs. Forests http://www.uni-goettingen.de/de/diversity-in-seed-rain-of-oil-palm-plantation-vs-forests-birte-cordts/489338.html
B11	**Arns, Jennifer**	Herbivory and its effects on tree growth and tree survival in an enrichment planting experiment in Jambi, Sumatra http://www.uni-goettingen.de/de/herbivory-and-its-effects-on-tree-growth-and-tree-survival-in-an-enrichment-planting-experiment-in-jambi-sumatra-jennifer-arns/506422.html

II. Integration of Ecological and Socioeconomic Research

Integration / integrative research activities across disciplines in the CRC is realized through

- the establishment of a joint enrichment planting experiment (B11)
- four thematic foci / overarching joint hypotheses.

1. The enrichement experiment

B11

Part of the B11 team in front of a planted Sungkai (Peronema canescens) tree: Field trip to the experiment in Humus Indo during the CRC workshop in Jambi, October 2014 From left to right: Holger Kreft, Anne Gerard, Miriam Teuscher.

TITLE: **Reproductive strategies of flowering plants in tropical rainforest transformation systems**

TEAM: Principle Investigators: Holger Kreft, Ulrich Brose, Dirk Hoelscher, Yann Clough, Meike Wollni (UGoe); Hendrayanto, Leti Sundawati, Prijanto Pamoengkas (IPB); Bambang Irawan
Scientific staff: Miriam Teuscher, Anne Gérard (PhD students)

PROGRESS / CURRENT STATUS

One year after the establishment of the B11 enrichment planting experiment on the plantation of PT Humusindo, we can report that most trees are developing well. However, the establishment success of the trees in the tree islands differs between the six native species (Parkia speciose (Petai), Fabaceae; Archidendron pauciflorum (Jengkol), Fabaceae; Durio zibethinus (Durian), Malvaceae; Dyera polyphylla (Jelutung), Apocynaceae; Peronema canescens (Sungkai), Lamiaceae; Shorea leprosula (Meranti), Dipterocarpaceae). The total mortality rate was 23.3 % (i. e. 1482 of 6354 initially planted trees died in the first year), with the lowest rate for Meranti (13.2 %) and the highest one for Jelutung (48.7 %).
Mortality, height and basal diameter of planted trees were measured every 3 months, and first results show that growth rates differ significantly ($p<0.01$) between species. Additionally, in each plot, soil samples were taken in three depths. The result of the soil texture study showed a broad variety in the relatively small experiment area (140 ha).

Regarding the diversity response of birds and invertebrates to the enrichment plantings, preliminary results indicate that there is no significant effect of the tree islands on the diversity of birds or invertebrates after one year of establishment. However, further analyses are still in progress.
In the framework of a MSc thesis by Robin Naumann, aerial photographs were taken from the experimental site by means of an unmanned aerial vehicle. The high resolution image allows us to study the effect of the landscape matrix on our experiment.
The seed rain in the plantation was monitored in nine spots distributed over the experimental site. We found seeds of 13 different species in the seed traps, and one weedy species (Asystasia gangetica) was particularly abundant. In an ongoing MSc thesis by Birte Cordts, we extended the seed rain study to a forest remnant in proximity to the experiment as well as to a transect between the two sites, and to the CRC plots in Harapan Rainforest.
In a third MSc project by Jennifer Arns, we plan to study herbivory and its effects on tree growth and tree survival. Jennifer will start her field work in May 2015.
Mr Watit Khokthong will be a new PhD student in the project. He will work on the tree seedling establishment and ecology in the experimental plantations.

B11, C08 integrative study

TITLE: **How much is a bird? Bird diversity in smallholder oil palm plantations**

REPRESENTATIVES: Miriam Teuscher, Miriam Vorlaufer, Yann Clough, Uli Brose, Meike Wollni

PROGRESS / CURRENT STATUS

How much is a bird? Trade-off between bird diversity and abundance, yields and revenue in smallholder oil palm plantations (Teuscher, Vorlaufer, Wollni, Brose, Mulyani, Clough) – under Review Biological Conservation

- Increases in bird diversity (conditional on increases in the number of trees) are associated with losses in revenue à trade-off between ecological and economic functions.
- Marginal costs of bird diversity gain changes with the number of trees in oil palm plantation (non-linear relationship).
- In intensively managed oil palm plantations (few trees) a relatively high increase in bird species richness could be achieved at relatively low cost.

2. Four thematic foci

Focus 1

TITLE: **Assessment of ecological and socio-economic functions across tropical transformation systems**

REPRESENTATIVES: Yann Clough, Ingo Grass, Oliver Mußhoff & Edzo Veldkamp

PROGRESS / CURRENT STATUS

Focus 1 is working on a transdisciplinary empirical paper aiming at answering the following questions: (1) What are the land-use patterns among smallholders in the study region, and what are the common land-use trajectories? (2) What is the land-use intensity by smallholders in the different land-use types? (3) How do the different land-use types compare in terms of stocks, processes and ecosystem services? (4) How do these stocks, processes and ecosystem services trade-off against each other? (5) What are the implications for policy and management?

Outlook 2nd phase

Focus 1 will remain an integral part of EFForTS, gathering and synthesizing information on ecological and socio-economic functions at the local scale. Focus 1 will aim at identifying socioeconomic-ecological trade-offs and synergies under varying management conditions. Following the transition of Yann Clough from Georg-August-University Göttingen to Lund University, Ingo Grass (B09) succeeds as speaker of Focus 1.

- Title: Assessment of ecological and socio-economic functions across tropical transformation systems
- Representatives: Ingo Grass, Oliver Mußhoff
- Hypotheses: (1) Continuation of previous assessments and integration of new ecological and socioeconomic will strengthen the evidence from the first period of EFForTS that the transformation of tropical lowland rainforest into intensive monoculture productions systems is associated with strong ecological-socioeconomic trade-offs. (2) Differences in management or ecological setting of oil palm plantations exceed interactive effects on multiple ecological and socioeconomic functions, resulting in non-linear relationships and both synergies and trade-offs. (3) The enrichment of oil palm plantations by planting of indigenous trees mitigates the ecological-socioeconomic trade-offs that are associated with the conversion of tropical lowland rainforest to oil palm monoculture.

Focus 3

TITLE: **Scaling-up of ecological and socioeconomic functions from local to landscape and broader scales**

REPRESENTATIVES: Stephan Klasen & Katrin Meyer

PROGRESS / CURRENT STATUS

We are close to completing a conceptual paper on specialization and scales which is currently finalized for submission. The rationale of the paper is that specialization in agricultural systems inevitably leads to trade-offs between economic gains and ecosystem functions. Economic gains can be maximized when production activities are specialized at increasingly higher scales (from the household to the village, region or above), particularly when markets for outputs and inputs function well and allow specialization as well as high levels of food security. Conversely, a tendency toward specialization likely reduces biodiversity and significantly limits ecosystem functions at the local scale. Agricultural specialization increases and moves to higher scales as a result of improved transportation and well-functioning market infrastructure. The degree of infrastructural development thus affects the severity of the trade-offs. Our paper takes Jambi province, a current hotspot of rubber and oil palm monoculture, as a case study. In doing so, it empirically investigates the trade-offs between economic gains and ecosystem functions for three spatial scales (i.e. household, village, and region) and discusses ways to resolve this trade-off. Figure 20 suggests that there is, as expected, greater homogeneity of land use types at lower spatial scales and higher diversity at higher scales. But there are also important differences between villages in different settings.

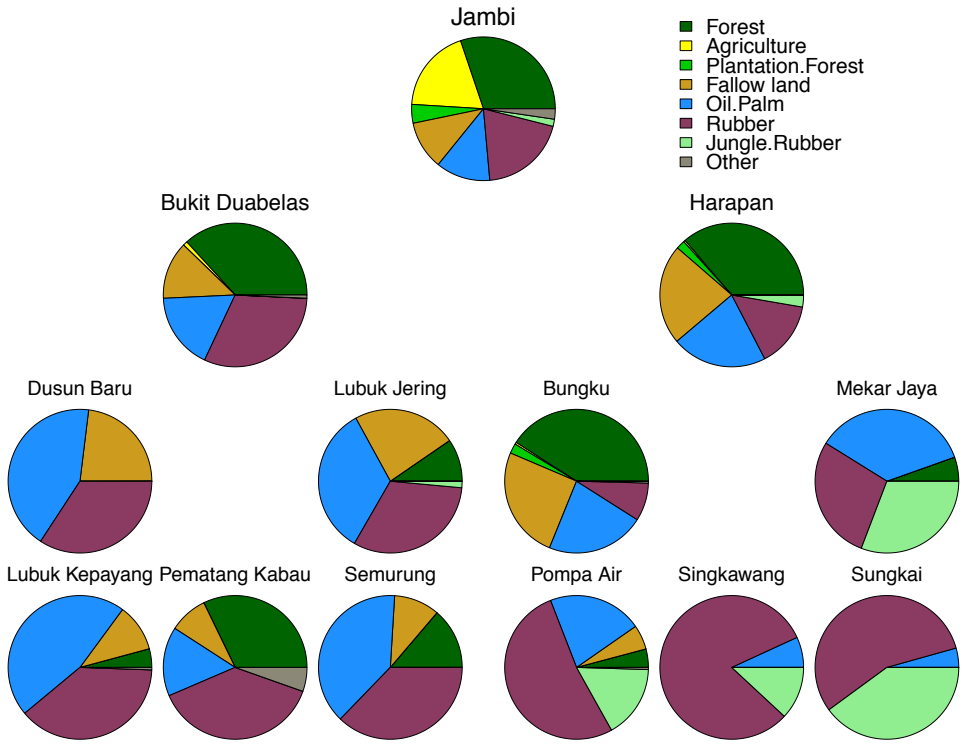


Fig. 20: Land use types in the province of Jambi in Indonesia in 2011 show that specialization decreased from fine to broad scales, i.e. from the village level (five villages per region, bottom rows) to the region level (Bukit Duabelas and Harapan, second row) to Jambi province (top row).

Focus 4

TITLE: **Towards more sustainable land use in lowland tropical regions**

REPRESENTATIVES:

Bernhard Brümmer & Teja Tscharntke

This review paper focuses on (direct) land use policy, trade policy, standards and guidelines as well as environmental policy, comparing inventory of policies at local, national, (and regional) scales. A review of policies impacting land use in Indonesia needs identifying changes with context, interdependencies as well as intended and unintended potential impacts at different temporal and spatial scales.

The policy inventory focus on oil palm and rubber addressing the general framework, e.g. food self-sufficiency objectives, land-use policies (e.g., regulatory frameworks), domestic policies with outputs (e.g., RASKIN, consumer) and inputs (e.g., subsidies for fertilizer, HET, BLP; credits, KPEN-RP), trade policies, including tariffs & export taxes and non-tariff measures, as well as short-run policies (e.g., food price crisis 2007/08) such as short-run import permissions for rice.

The review of policies impacting land use in Indonesia with potential generalizations and reliable models needs to consider

(i) Land use policies (Vijesh)
(ii) Trade policies (Bernhard)
(iii) Standards and technical regulations (Jann)
(iv) Environmental policies – volunteers needed!

Scenarios of socioeconomic-ecological tradeoffs in tropical land use
(lead author: Teja Tscharntke)

There is evidence that there is often much room for balancing economic and ecological needs and for finding low cost-high benefit solutions.

Potential generalizations and reliable models addressing the complexity and diversity of the relationships between ecological and economic goods (see the figure below) need to consider

(i) the multiple factors involved,
(ii) the multifunctionality of land-use systems
(iii) the context and scale dependency of all socioeconomic-environmental relationships (short vs long term, local to global perspectives, socio-cultural and political context).

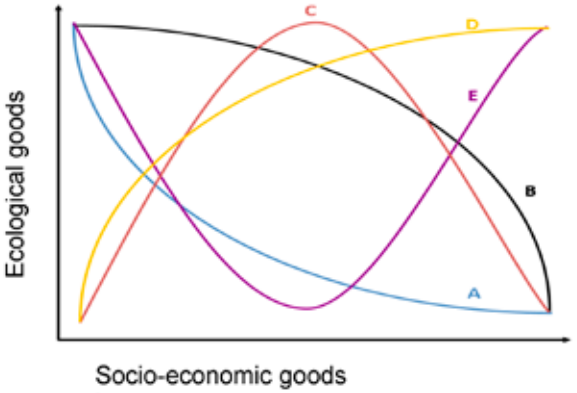


Fig. 21: Scenarios of socioeconomic-ecological tradeoffs
A The Environmentalist's Paradox,
B Agroecological intensification,
C Win-win solutions I,
D Win-win solutions II,
E The Environmental Kuznets Curve.

III. Publications

Barnes, A. D.*, Jochum, M.*, Mumme, S., Haneda, N.F., Farajallah, A., Widarto, T.H., Brose, U. (2014): Consequences of tropical land use for multitrophic biodiversity and ecosystem functioning. Nature Communications 5:5351 doi: 10.1038/ncomms6351. ** shared first-authorship*

Beckert, B., Dittrich, C., Adiwibowo, S. (2014): Contested land: An analysis of multi-layered conflicts in Jambi province, Sumatra, Indonesia. ASEAS – Austrian Journal of South-East Asian Studies, 7(1): 75-92.

Euler, M., Schwarze, S., Siregar, H., Qaim, M. (2015) : Oil Palm Expansion among Smallholder Farmers in Sumatra, Indonesia. EFForTS Discussion Paper 8, University of Göttingen.

Guillaume, T., Muhammad, D., Kuzyakov, Y. (2015): Losses of soil carbon by converting tropical forest to plantations: Erosion and decomposition estimated by δ13C. Global Change Biology (in press).

Krishna, V.V., Pascual, U., Qaim, M. (2014): Do Emerging Land Markets Promote Forestland Appropriation? Evidence from Indonesia. EFForTS Discussion Paper 7, University of Göttingen.

Niu, F. R., Röll, A., Hardanto, A., Meijide, A., Köhler, M., Hendrayanto, Hölscher, D. (2015): Oil palm water use: calibration of a sap flux method and a field measurement scheme. Tree Physiology (in press).

IV. International Conferences / Presentations

The 5th Geographic Object-Based Image Analysis (GEOBIA) Conference
Thessaloniki, Greece, 21–24 May, 2014

B05

TITLE: Object-based classification of land use transformation systems in a forested tropical landscape using RapidEye satellite imagery.

AUTHORS: Dian N. Melati**,** Paul Magdon, Hans Fuchs, César Pérez-Cruzado, Lutz Fehrmann, and Christoph Kleinn.

International Expert Seminar on Water, Climate Changes and Agriculture
Bogor, Indonesia, 23 –27 June, 2014

B10 – IPB

TITLE: Sustainable water management of agriculture catchment undergoing rapid expansion of oil palm plantation.

AUTHORS: Surya Tarigan, Bejo Slamet, Sunarti, Stevany Putri.

International Conference "Carbon – Land – Property"
Copenhagen, Denmark, 1– 4 July, 2014

C02

TITLE: Exclusions as consequences of REDD+ and conservation? – A case study from Jambi, Indonesia.

AUTHORS: Jonas Hein, Heiko Faust, Soeryo Adiwibowo, Endriatmo Soetarto.

XIVth Congress of the European Association of Agricultural Economists
Ljubljana, Slovenia, 26–29 August, 2014.

C08 & C07

TITLE: Oil Palm Boom and Land-Use Dynamics in Indonesia: The Role of Policies and Institutions.

AUTHORS: Marcel Gatto, Meike Wollni, Matin Qaim.

C08

TITLE: Equity vs. Conservation: Can Payments for environmental services achieve both?

AUTHORS: Miriam Vorlaufer, Meike Wollni, Marcela Ibanez.

GFÖ Annual Meeting
Hildesheim, Germany, 8–12 September, 2014

A02

TITLE: Water use of oil palms: calibration of a sap flux method and first results.

AUTHORS: Niu, F.R., Röll, A., Hardanto, A., Hanf, A., Hendrayanto, Junedi, H., Köhler, M., Hölscher, D..

The Annual Conference on Tropical and Subtropical Agricultural and Natural Resource Management – Tropentag 2014
"Bridging the gap between increasing knowledge and decreasing resources"
Prague, Czech Republic, 17–19 September 2014

B09

TITLE: Management of homegardens in Indonesian agricultural landscapes and its impact on invertebrate diversity.

AUTHORS: Manuel Toledo-Hernandez , Lisa H Denmead, Yann Clough and Teja Tscharntke.

C04

TITLE: Shocks and Its Implication on Food Security of the Vulnerable Households in Indonesia.

AUTHOR: Dewi Nur Asih

A03

TITLE: Water use by rubber and oil palm plantations in the lowlands of Jambi, Indonesia.

AUTHORS: Hardanto, A., Röll, A., Niu, F.R., Hanf, A., Junedi, H., Hendrayanto, Hölscher, D..

Workshop "Designing disease-resistant landscapes"
Complex Adaptive Systems Program, Wageningen, The Netherlands, 6 October, 2014

B10

TITLE: Modelling ecological interactions across scales.

AUTHOR: Katrin Meyer (keynote).

XXIV IUFRO World Congress: *"Sustaining Forests, Sustaining People: The Role of Research"*
Salt Lake City, United States, 5–11 October, 2014

A02

TITLE: Forest vs. oil palm: the differences in plant water use.

AUTHORS: Röll, A., Niu, F.R., Hardanto, A., Hanf, A., Junedi, H., Hendrayanto, Hölscher, D..

Annual conference of the Swiss Ethnological Society SEG-SSE – Social Anthropology and Global Transformations
Basel, Switzerland, 1 November, 2014

C03 & C02

TITLE: Is indigenous land titling an act of justice? Indigeneity as category of empowerment in the context of land use conflicts. A case study from Jambi Province, Sumatra, Indonesia.

AUTHORS: Stefanie Steinebach & Yvonne Kunz

Annual Meeting Arbeitskreis Südostasien in der Deutschen Gesellschaft für Geographie (DGfG)
Cologne, Germany, 14-16 November, 2014

C02

TITLE: A contested oil palm frontier. An analysis of multi-layered conflicts over land, carbon and conservation in Jambi.

AUTHORS: Barbara Beckert, Jonas Hein.

Joint Annual Meeting of the British Ecological Society and Société Française d'Ecologie
Lille, France, 9–12 December, 2014

B01

TITLE: Consequences of tropical land use for multitrophic biodiversity and ecosystem functioning.

AUTHORS: Andrew D. Barnes, Malte Jochum, Steffen Mumme, Noor F. Haneda, Achmad Farajallah, Tri Heru Widarto and Ulrich Brose.

International Biogeography Society Meeting; Bayreuth, Germany, 8–11 January, 2015

B01

TITLE: Consequences of tropical land use for multitrophic biodiversity and ecosystem functioning.

AUTHORS: Andrew D. Barnes, Malte Jochum, Steffen Mumme, Noor F. Haneda, Achmad Farajallah, Tri Heru Widarto and Ulrich Brose.

1st Annual meeting in Conservation Genetics, Science and Practice
Birmensdorf, Switzerland, 28–30 January, 2015

B03

TITLE: Is the intraspecific genetic plant diversity associated with the species diversity?

AUTHORS: Natalie Breidenbach, Iskandar Z. Siregar and Reiner Finkeldey.

International Workshop on Forest Carbon Emissions "Research and Systematic Observation (RSO) for Forest-Peat Carbon"
Jakarta, Indonesia, 3–5 March, 2015

B05

TITLE: Spatio-temporal analysis on land transformation in a forested tropical landscape in Jambi Province, Sumatra.

AUTHORS: Dian N. Melati, I Nengah Surati Jaya, César Pérez-Cruzado, Muhammad Zuhdi, Lutz Fehrmann, Paul Magdon and Christoph Kleinn.

B03

TITLE: Plant genetic diversity in tropical lowland rainforest transformation systems (Indonesia).

AUTHORS: Natalie Breidenbach, Iskandar Z. Siregar and Reiner Finkeldey.

Annual Conference of the Society for Tropical Ecology; Zürich, Switzerland, 7–10 April, 2015

A02

TITLE: Differences in transpiration among rainforest and transformation systems.

AUTHORS: Alexander Röll, Niu Furong, Hardanto, Hendrayanto, Dirk Hölscher.

Annual Conference of the Society for Tropical Ecology (GTÖ): *"Resilience of Tropical Ecosystems: Future Challenges and Opportunities"*
Zürich, Switzerland, 7–10 April, 2015

A03

TITLE: Evapotranspiration components determined by eddy covariance and sap flux measurements in oil palm plantations in Sumatra, Indonesia.

AUTHORS: Ana Meijide, Alexander Röll, Furong Niu, Tania June, Dirk Hölscher Alexander Knohl.

European Geosciences Union, General Assembly 2015; Vienna, Austria, 12–17 April, 2015

A04

TITLE: Losses of soil carbon by converting tropical forest to plantations: Assessment of erosion and decomposition by new δ13C approach.

AUTHORS: Thomas Guillaume, Damris Muhammad and Yakov Kuzyakov.

B05

TITLE: Spatio-temporal analysis on land transformation in a forested tropical landscape in Jambi Province, Sumatra.

AUTHORS: Dian N. Melati, I Nengah Surati Jaya, César Pérez-Cruzado, Muhammad Zuhdi, Lutz Fehrmann, Paul Magdon and Christoph Kleinn.

The International Association for the Study of the Commons, Biannual Meeting
Edmonton, Canada, 25 –29 May, 2015

C02

TITLE: Interpreting an Open Access Resource and the Strategic Knowledge for Accessing over Forestland in Jambi Province, Sumatra, Indonesia.

AUTHOR: Rina Mardiana (abstract accepted).

Southeast Asian Studies in Asia Conference (SEASIA); Kyoto, Japan, 12 –13 December, 2015

C02

TITLE: Land Grabs and Rural Resistances in Jambi, Indonesia.

AUTHORS: Rina Mardiana (abstract accepted).

V. News from Indonesia

1. Research projects funded by Indonesian government

1.1. IPB Operational Block Grant (BOPTN)

Scheme#1: International Research Collaboration and Publication
Source: http://simlitabmas.dikti.go.id/

New research projects

TITLE: Dissolved 0rganic carbon and nutrient leaching in the Bukit Dua Belas Nasional Park.
Prof. Dr.Kukuh Murtilaksono – IPB
(Counterpart of A04)

Project extensions

TITLE: Practical Application of DNA Barcoding for Conservation of Endangered Tree Species.
Prof. Iskandar Z. Siregar – IPB
(Counterpart of B03)

TITLE: Impacts of oil palm plantation and forest patches landscape mosaic on catchment water balance.
Dr Suria Darma Tarigan – IPB
(Counterpart of B10)

Scheme#2: University Reserch Excellence

New research projects

TITLE: Land transfer, social vulnerability, conservation, and economic development in Jambi, Indonesia.
Dr. Soeryo Adiwibowo
(Counterpart of C02)

TITLE: Interaksi tropik anatar tanaman, hama dan musuh alami pada perkebunan kelapa sawit di Jambi. *(Tropic interaction between plants, pest, natural enemy in oil palm in Jambi).*
Dr. Pudjianto
(Counterpart of B09)

TITLE: Pemanfatan Bakteri Tanah yang potensial dari hutan transformasi sekitar taman nasional Bukit Dua Belas Jambi pada tanaman semai kelapa sawit *(The use of potential soil bacteria from around National Park Bukit Duabelas for oil palm seedlings).*
Dr. Pudjianto
(Counterpart of B09)

Project extensions

TITLE: Konservasi Air Dan Tanah Dengan Legum Pada Berbagai Kemiringan Kebun Sawit Dan Karet Di Kawasan Hutan Harapan Di Jambi *(Soil and water conservation with legumes on different slopes of oil palm and rubber plantation around Harapan Rainforest-Jambi).*
Herdhata Agusta
(Counterpart of A02)

New research projects

TITLE: Konservasi Air Dan Tanah Dengan Legum Pada Berbagai Kemiringan Kebun Sawit Dan Karet Di Kawasan Hutan Harapan Di Jambi *(Soil and water conservation with legumes on different slopes of oil palm and rubber plantation around Harapan Rainforest-Jambi)*
Dr. Herdhata Agusta – IPB
(Counterpart of A02)

2. Conferences, Seminars, Workshops

IPB – Workshops

a. A workshop on *"Eddy covariance: data collection, correction and analysis"* was given by Ana Meijide on February 11, 2015.

b. A workshop on *"Implementation of the Nagoya Protocol"* took place on June 23, 2014. The objectives of the workshop were to 1) outline major problems on the operational level related to the implementation of the Nagoya Protocol, and to 2) develop suggestions for appropriate alternative solutions.

c. A workshop on *"Agent-based modeling"* was given by Claudia Dislich on October 14–15, 2014. Participants learned how to implement and evaluate simple models with the open source modeling platform NetLogo.

d. A workshop on *„Scientific practice & policy interfacing related to the management of lowland rainforest transformation systems"* was held on November 21, 2014.

The objective of the workshop was how to establish links between scientific research of the CRC 990 and policy making, e. g. policy briefs and / or technical guidelines.

Group picture from the workshop on agent-based modelling held in October 2014 in Bogor.

Participants of the workshop *Scientific practice & policy interfacing related to the management of lowland rainforest transformation systems*

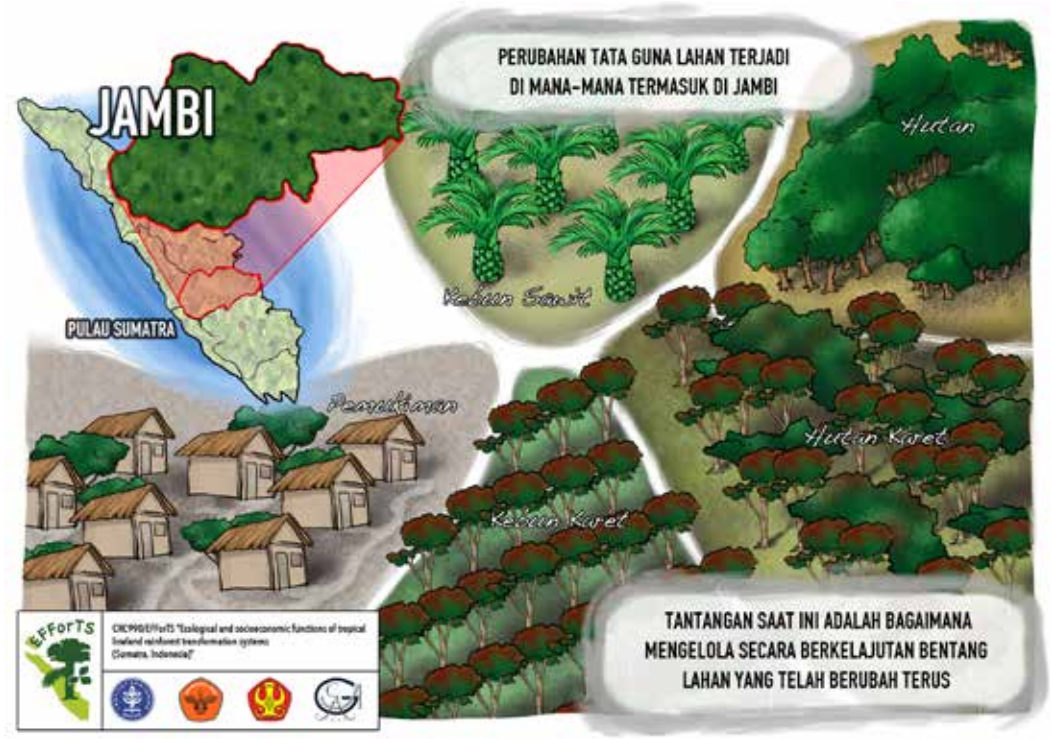
Proposed themes for policy briefs were:

- Water Conservation In Palm Oil Plantation (Dr. Herdata Agusta – Counterpart A02)
- Land allocation for the sustainability of ecosystem services in Jambi (Dr. Surya Tarigan – Counterpart B10)
- Management of soil fauna in oil palm plantations (Dr. Noor F. Haneda – Counterpart B01)
- Agroforestry Development Strategy (Based on Palm Oil) in Jambi (Dr. Leti Sundawati – Counterpart B10)
- Palm Oil : Is it true that have been bad environmental impact? (Dr. Tania June – Counterpart A03)
- Keeping Freshwater Biota Components in Water Flow Across the Plantation (Dr. Achmad Farajalah – Counterpart B01)
- The Role of litter as soil nutrient inputs in Palm Oil Plantation (Dr Triadiati – Counterpart B04).

Proposed themes for Technical Guidlelines were:

- Enrichment Planting to improve productivity (Dr. Prijanto Pamungkas)
- Cultivation of Sungkai (Peronema canescens) (Prof. Dr. Sri Wilarso – Counterpart B07)

A cartoon for oil palm smallholders on *"Management of Soil Fauna in Oil Palm Plantation"* has been designed as possible policy advice instrument. The cartoon contains simple explanations of the importance of leaf litter and soil fauna for sustainable and recource saving oil palm management.



An example of a book cartoon. Text: Dr. Noor F. Haneda, Dr. Dr. Heru Tri Widarto, Dr. Ahmad Farajalah (IPB) Ilustrator: Wondo

IPB – Colloquium

In 2014 and 2015 a series of interdisciplinary talks of researchers of the CRC 990 have been given at IPB and SEAMEO BIOTROP.

April 11, 2014 **Martyna M. Kotowska (B04)**

Above and belowground biomass, net primary productivity and carbon sequestration in lowland rainforest transformation systems in Sumatra.

August 25, 2014 **Katja Rembold (B06)**

From project sketch to journal publication: reserch on land cover change and it's consequences for plant diversity.

August 27, 2014 **Robin Naumann (B11)**

Generation of digital elevation model and a canopy map of the CRC 990 research area in Jambi Province of Sumatra, with the use of remote imaginery captured by an Unmanned Aerial Vehicle (UAV).

August 28, 2014 **Siria Biogonia (A01)**

Palynology: material, methods and application in biological science.

October 6, 2014 **Andrea Polle (B07)**

The role of mycorrhizas in tree nutrition probed by stable isotopes.

October 15, 2014 **Malte Jochum (B01)**

Structure, stability and functioning of macro-invertebrate communities in rainforest transformation systems in Sumatra (Indonesia).

Februray 11, 2015 **Ana Meijide (A03)**

Eddy Covariance: data collection, correction and anaysis.

Februray 24, 2015 **Lisa Denmead (B09)**

Does biodiveristy loss from palm plantations impact production?

Management of homegardens in indonesia agricultural landscpaes and it's impact on invertebrate communities.

UNJA – Workshop

a. A training workshop by UNJA and the National Park Bukit Duabelas (TNBD) on „Jernang (Dragon Blood) Cultivation and Processing" took place on April 28–30, 2014 and on May 1–3, 2014. Sapplings of Jernang have been cultivated and planted and demonstration plots have been established with support of TNBD.

b. A two-day workshop on *"Palynology"* was given by Asmadi Saad and Hermann Behling on Oct 2–3 2014. The workshop focused on fundamentals of paleoecology and pollen morphology-with emphasis on Indonesia.

UNJA – Symposium

A symposium on "Biodiversity research, access to genetic resources and benefit sharing (ABS)" took place on 26 September 2014.

Speakers and topics:

Dr. Bambang Irawan: Flowering and Fruiting Ecology of Ironwood *(Eusideroxylon Zwageri Teijsm & Binn.)*.

Dr. Ir. Rosyani: SAD Community Institutional Development and Its Impact on Environmental Changes (Research on SAD Community around TNBD).

Dr. Revis Asra: Diversity of Dragon's Blood Palm *(Daemonorops spp.)* in Bukit Duabelas National Park, Sumatra, Indonesia.

Dr. Wilyus: Community Plantation as Alternative Conflict Resolution on Concession of PT. REKI (Indonesian Ecosystem Restoration) in Jambi Province.

Dr. Lutfi Izhar: Forest (HTR) Community Plantation as Alternative Conflict Resolution on PT. REKI Concession in Jambi Province.

Prof. Damris: UV and FTIR Characterization of Dissolved Organic Carbon in soil extracts and leachates from Tropical Lowland Rainforest Transformation Systems.

Dr. Asmadi Saad: Tropical Modern Pollen Collection as a Tool to Interpret the Quaternary Fossil Pollen Records in Sumatra, Indonesia.

Dr. Sunarti: The distribution of soil organic carbon and its relevance for soil water content in oil palm plantations.

Luce: Nutrient Input and Decomposition in High and Low Quality Lowland Secondary Tropical Rain Forest.

3. News from Universities – IPB

1. Launch of website

A Website of activities of scientists and students of IPB in relation to the CRC 990 has been launched. This website is in Bahasa Indonesia and serves as additional communication tool. Link: http://efforts.ipb.ac.id/.Part of the meeting included a short presentation of the CRC 990.

VI. Cooperation

Status of agreements of the CRC 990:

Signed:	
MoU	LIPi –IPB extended
MoU	BMKG – IPB
MoA	UNJA – Taman Nasional Berbak

MoA: Memorandum of Agreement
MoU: Memorandum of Understanding

The EFForTS Data Base Mirror Server has been implemented at LIPI, Cibinong on January 12, 2014.

2. Status workshop of the CRC 990

The third status workshop of the CRC 990 was held at Jambi, Indonesia on October 8–10, 2014 (http://www.uni-goettingen.de/en/2014/489237.html).

From left to right: Prof. Reiner Finkeldey (Vice President Reserach, University of Göttingen), Prof. Damayanti Buchori (IPB), Dr. Delima Azahari (President Commissioner of PTPN VI), Prof. Stefan Scheu (Speaker of the CRC 990), Harlik (Jambi Estate Crop Development, BAPPEDA Jambi Province), Dr. Herdrajat Natawidjaya (Director of Perennial Crop, Directorate General of Estate, Ministry of Agriculture).

From left to right: Dr. Adam Malik. (University of Tadulako), Prof. Stefan Scheu (Speaker of the CRC 990), Dr. Bambang Irawan (University of Jambi), Prof. Iskandar Z. Siregar (IPB), Prof. Reiner Finkeldey (Vice President Research, University of Göttingen), Dr. Abdul Rauf (University of Tadulako).

3. Visit of the President of the University of Göttingen of Bogor and Jambi

President Beisiegel visited Bogor and Jambi from August 14 –15, 2014.
At the Symposium on *University Governance* at IPB on August 14 she gave a keynote on *Challenges and lessons learned*.
Further, together with the Rector of IPB – Prof. Dr. Herry Suhardiyanto – she inaugurated the Göttingen Alumni Lounge.

On August 15, she visited the Univeristy of Jambi where she met with senate members of UNJA. Prof. Beisiegel also went to Bungku to visit the research plots of the CRC 990.

Visit of President Beisiegel at Bungku

From left to right: Uwe Muuss (Director Göttingen International), Prof. Dr. Herry Suhardiyanto (Rector IPB), Prof. Dr. Anas Fauzi (Vice Rector Research and Collaboration, IPB), Prof. Dr. Ulrike Beisiegel (President University of Göttingen).

Georg-August-Universität Göttingen (UGoe)

Institut Pertanian Bogor (IPB)

Universitas Jambi (UNJA)

Universitas Tadulako Palu (UNTAD)

Speaker CRC 990

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