CRC 990 - EFForTS

NEWSLETTER

Mid-Term Project &
Research Progress
PHASE 2
2016–2017

Issue 5 / Oct 2017

Cover:
Left: Brick production in Jambi province
(Photo: Jochen Drescher).
Right: Evening atmosphere at a river in Jambi province
(Photo: Jennifer Merten).

Content

Acknowledgement from the Speakers

Z01 – Central tasks

Management

The Joint Management Board Indonesia designated new members:

- At UNJA, Prof. Ade Octaviani (scientific affairs) took over the position from Prof. Adriani, and Prof. Sri Wachyunni (administrative affairs) succeeded our deceased colleague Prof. Adrizal.
- At UNTAD, Prof. Donny M. Mangitung (Head of Research and Outreach Centre) succeeded Prof. Sultan.

Coordination Indonesia:

- In agreement with the recommendation of the DFG the tasks of the EFForTS coordination office at UNJA were expanded to strengthen the local infrastructure and capacity building measures. The Management Boards in Göttingen and Indonesia have endorsed this advice.
- As of January 2017, Dr. Aiyen Tjoa took on the responsibilities as head of the EFForTS office at UNJA. As of November 2017, Dr. Sunny Reetz will be responsible as project coordinator of the EFForTS office at IPB.

Agreements

In Phase 2, a couple of new memoranda of agreement (MoA) have been signed:

- The MoA between the Indonesian University Consortium and PT Perkebunan Nusantara VI (PTPN VI) has been signed on 7 December 2016 by the new director of PTPN VI, Mr. Ahmad Haslan Saragih (succeeding Mr. Iskandar), by Prof. Dr. Ir. H. Zulkifli Alamsyah – Vice Rector for Planning, Collaboration Affair and Information Systems at UNJA on behalf of the Consortium –, and by Prof. Dr. Anas M. Fauzi, Speaker of the Indonesian University Consortium as witness. The agreement includes the cooperation with the oil palm management experiment of EFForTS.
- The MoA between the Indonesian University Consortium and the National Park Bukit Duabelas (TNBD) has been extended on 7 December 2016. It has been signed by Prof. Dr. Johni Najwan, Rector of UNJA on behalf of the Consortium, by Prof. Dr. Anas M. Fauzi, Speaker of the Consortium as witness and by Dr. R. Radjendra Supriadi, Head of the National Park Authority.
- The Memorandum of Agreement the extension of the MoA between the University of Göttingen and the Indonesian University Consortium is in its final stage of conclusion and is expected to be signed in November 2017.

Photo 1: Signing of the extension of the plot contracts for the Harapan landscape on 1 April 2017 in the house of Pak Abdul Rajak.

Furthermore, plot contracts were extended in 2016:

- The official signing of the cooperation agreements / plot contracts with farmers took place on 31 March 2016 for plots in the Bukit Duabelas landscape, on 1 April 2016 for plots in the Harapan landscape, and on 19 April 2016 for the new riparian core plots in the Harapan landscape (Photo 1).

Research infrastructure and logistics

- In 2016, the new core plots in the riparian areas (12 plots) and at PTPN VI (16 plots, oil palm management experiment) have been established and plot measurements recorded. Copies are available on the SharePoint (https://sharepoint.uni-goettingen.de/projects/sfbindo2/default.aspx) and at the office at UNJA.
- The organization of the plot management has been restructured. A core team of 6 field assistants under the supervision of Aiyen Tjoa will be responsible for the maintenance and repair of the sites, the data collection, litter sampling and coordination with plot owners.
- Supporting logistics and common infrastructure (housing and vehicles) has been expanded in Phase 2. Currently, 4 vehicles and 26 motorbikes ensure transportation of researchers and equipment. Further, 3 field houses are available at Muara Bulian, Batu Kucing and Bungku, and 4 houses in Jambi city.
- The electrical installation and the water supply system of the office and lab at UNJA was modernised

Photo 2: Field visit of EFForTS team (Z01, A05, B11) of Muara Jambi in February 2017. From left to right: Junaidi, "Driver", Greta, Clara, Mega, Andrea, Rizky, Joost, Dessy, Barbara, Aiyen, Yuking, Andry, Epriansyah, Fahrozi.

Photo 3: Meeting of the delegates of the Ministry of Foreign Affairs and the Council of Palm Oil Producing Countries, Indonesia with EFForTS representatives and the vice rector of UNJA on July 26, 2017. From left to right: Dr. Suria Tarigan (IPB), Dr. Bambang Irawan (UNJA representative of EFForTS), Prof. Zulkifli Alamsyah (Vice rector of UNJA), Dr. Aiyen Tjoa (EFForTS coordinator in Jambi), Dr. Siswo Pramono (Deputy head of BPPK), Dr. Leonard F. Hutabarat (Head P3K2), Mr. Iman Y. Fakhrudin (Officer at CPOC), Mr. Benny K. Rahman (Officer at P3K2).

and upgraded to comply with safety requirements and to improve the supply reliability.

Guest Visits – official visits

Representatives of The Ministry of Foreign Affairs, Indonesia (BPPK Kemlu) and the Council of Palm Oil Producing Countries, Indonesia visited EFForTS project sites and the University of Jambi (UNJA) from July 26 to 28, 2017. Occasion of the visit was to get a better understanding of the research activities of EFForTS (here: management of palm oil plantations and the B11 Enrichment Experiment) and to discuss opportunities of cooperation with UNJA. Representatives of the Ministry of Foreign Affairs were:

- Dr. Siswo Pramono (Deputy head of the Policy Analysis and Development Agency of the Ministry of Foreign Affairs, BPPK)
- Dr. Leonard F. Hutabarat (Head of the Center for Policy Analysis and Development for America and Europe, P3K2)
- Mr. Benny K. Rahman (Officer of P3K2)
- Mr. Mahendra Siregar (Executive Director of the Council of Palm Oil Producing Countries (CPOPC)
- Mr. Iman Y. Fakhrudin (Officer of CPOPC) (Photo 3).

The first day of the visit started with a meeting at UNJA. Opening addresses were given by Prof. Zulkifli Alamsyah (vice rector of UNJA), Dr. Bambang Irawan (UNJA representative of EFForTS), Dr. Aiyen Tjoa (EFForTS coordinator in Jambi) and Dr. Suria Tarigan (counterpart B10, IPB). Outcome of

Photo 4: Visit of the delegates of the Ministry of Foreign Affairs and the Council of Palm Oil Producing Countries, Indonesia of the B11 Enrichment Experiment of EFForTS (BEE) at PT. Humusindo. From left to right: Mr. Iman Y. Fakhrudin (Officer at CPOC), Dr. Clara Zemp (postdoctoral researcher, BEE), Dr. Siswo Pramono (Deputy head of BPPK), Mr. Mahendra S., Dr. Bambang Irawan (UNJA representative of EFForTS), Dr. Aiyen Tjoa (EFForTS coordinator in Jambi), Mr. Edward S. (BEE staff), Mr. Benny K. Rahman (Officer at P3K2), Mr. Juliandi (BEE staff).

Photo 5: Visit of BEFTA team of EFForTS in Jambi on 20 and 21 Augiust 2017. From left to right: Yuking Linatra, Muhammad Fahrozi, Amy Eycott, Edgar Turner, William Foster, Lia, Sri Wachyunni, Aiyen Tjoa, Amelia Hood, Megawati, Eleanor Slade, Rizky Febrianty, Sarah Luke, Christian Stiegler.

the meeting: both BPPK and CPOC will support a summer school at both UNJA and IPB on oil palm management and land use.
On the following day, the delegation visited core plots of EFForTS at PTPN VI (site of the climate tower and the management experiment) where meetings with the director of PTPN VI and farmers took place. The last point was a visit of the B11 Enrichment Experiment (BEE) at PT. Humusindo. Expressions of interests / points of discussions were the scaling up of BEE at PTPN VI and PT. Humusindo (Photo 4).

On 20 and 21 August 2017, representatives of BEFTA (Biodiversity and Ecosystem Function in Tropical Agriculture, a research partnership between the University of Cambridge and SMARTRI / PT. Sinar Mas Agro Resources and Technology Research Institute in Pekanbaru, Indonesia) visited our field sites at PTPN VI (climate tower and oil palm management experiment) and PT. Humusindo (BEE): Dr. Edgar Turner (Curator of Insects, Museum of Zoology, University of Cambridge, UK), Dr. Eleanor Slade (Researcher, Department of Zoology, University of Oxford, UK), Dr. Amy Eycott (Postdoctoral researcher, Insect Ecology Group, Department of Zoology, University of Cambridge, UK), Dr. Sarah Luke (Postdoctoral researcher, Insect Ecology Group, Department of Zoology, University of Cambridge, UK), Dr. William Foster (Senior Lecturer, Department of Zoology, University of Cambridge, UK and speaker of BEFTA), Amelia Hood (doctoral researcher, Insect Ecology Group, Department of Zoology, University of Cambridge, UK).
The purpose of the visit was to establish networks and strategic partnerships with other scientific projects conducting research on palm oil management in Indonesia (Photo 5).

Photo 6: Participants of the symposium *"CRC 990: Towards Indonesian Sustainable Palm Oil"* hosted by the Ministry of Foreign Affairs on 11 September 2017 in Jakarta, Indonesia.

Photo 7: Demonstration of compost production to farmers in Bungku during the socialization event on 26 March 2017.

Symposium and collaboration with the Ministry of Foreign Affairs of the Republic of Indonesia

- The Agency for Policy Review and Development (BPPK) of The Ministry of Foreign Affairs, Indonesia hosted a special symposium entitled: *CRC 990: Towards Indonesian Sustainable Palm Oil* on 11 September 2017 in Jakarta to improve understanding on Indonesian sustainable palm oil industry.
- The EFForTS Consortium of Universities under the lead of IPB was invited to present research highlights of Phase 1: Anas M. Fauzi, Suria Tarigan, Iskandar Siregar, Leti Sundawati, Rosyani. Presentations were given by Aiyen Tjoa (overall project information and results of group A – Environmental processes), Bambang Irawan (results of group B – Biota and ecosystem services), and Hermanto Siregar (results of group C – Human dimensions).
- The seminar was opened by Mr. A. M. Fachir, Vice Minister – Foreign Affairs. It was attended by approximately 70 people: by the Executive Director of the Council of Palm Oil Producing Countries (CPOPC), Mahendra Siregar, the Expert Staff on Economic Diplomacy of the Ministry of Foreign Affairs Ridwan Hassan, Ambassadors and Representatives of Indonesian palm oil producing and using countries such as Germany, Italy, Colombia and Spain, as well as governmental and non-governmental organizations concerned with palm oil issues (Photo 6).
- The cooperation between IPB / the Consortium and The Ministry of Foreign Affairs shall be expanded. Plans for the future are
  1. A summer school on Indonesia sustainable palm oil, to be conducted from 19 November to 10 December at both IPB and UNJA. The summer school is de-

Photo 8: Aiyen (right) shows to farmers how to make pan-fried bananas.

Photo 9: Socialisation event in Bungku on 26 March 2017: Aiyen (1st row left), Bpk. Utut Adianto (Head of Bunku village, 1st row, center) Megawati (second in 2nd row left) and Yuking (3rd row left).

signed to provide participants with a solid understanding of oil palm production (at IPB) and have practical on-farm experiences (UNJA). Up to 10 international and 6 Indonesian participants will be funded by the Ministry of Foreign Affairs.

2. Research highlights of EFForTS will be summarized and documented in policy briefs for the interested public and policy makers / ministries. Funding will be provided by BPPK.

Socialization events in core villages

- In order to maintain / strengthen relations with the project's stakeholders and to engage in a constructive dialogue with them, four socialization events have been conducted in the Harapan landscape between February and May 2017 by Aiyen Tjoa, Gindo Tampubolon (Forestry Faculty, UNJA) and Bambang Irawan with support of Yuking and Megawati.
- Key objectives of the events were to (i) raise the awareness of the village authorities and to build trust with the village head, the plot owners, the villagers, (ii) to popularize the project's activities in the village in order to secure tools and equipment, and (iii) to participate in human capacity development in the partner villages.
- Formal presentations were given with regard to the activities of EFForTS, and on the role of nutrients for plant/oil palm productivity. A practical course was carried out on organic composting (Photo 7).
- Following the official meeting an informal get-together took place including a cookery course (Photo 8), movie watching, joint dinner:
  - ✓ Pompa Air, Sungkai and Singkawang on 24 February: 60 participants

Photo 10: Introduction of EFForTS to farmers during the socialisation event at Sungai Bahar on 28 April 2017. Presenter: Bambang Irawan.

- ✓ Bungku and PT Humusindo on 26 March: 57 participants (Photo 9).
- ✓ Sungai Bahar (Talang Bukit, Sumber Mulya, Mulaya Jaya) on 28 April: 50 participants (Photo 10).
- ✓ Muara Bulian on 15 May. The event was hosted by Bappeda, participants mainly came from governmental bodies.

- All participants received a certificate signed by the Rector of UNJA.
- Further socialization events are planned for the Bukit Duabelas landscape in October and November of this year.

Enjoy reading!

Prof. Stefan Scheu
(Speaker of EFForTS)

Prof. Anas Mifta Fauzi
(Speaker of the Indonesian University Consortium)

I. Mid-term project and research progress of Phase 2 (2016–2017)

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

Group A

FIELDS OF RESEARCH
- Environmental processes

GROUP COORDINATORS
Dirk Hölscher, Marife Core
(University of Göttingen, UGoe);
Suria Darma Tarigan
(Bogor Agricultural University, IPB);
Muhammad Damris
(University of Jambi, UNJA)

REPRESENTATIVES OF DOCTORAL/ POSTDOCTORAL RESEARCHERS
Florian Ellsäßer (A02)
Joost Koks (A05)

A01

TITLE: **Long-term vegetation dynamics, plant phenology and plant-pollinator interactions in rainforest and rainforest transformations in central Sumatra**

TEAM: Principal Investigators: Hermann Behling (UGoe), Supiandi Sabiham, Rika Raffiudin (IPB), Asmadi Saad, Yudhi Achnopha (UNJA).
Scientific Staff: Siria Biagioni (Postdoctoral Researcher).
Associated Scientists: Christina Ani Setyaningsih, Kartika Anggi Hapsari (Doctoral Researchers).

RESEARCH SUMMARY:

Multi-proxy palaeoecological analyses including pollen, testate amoebae, diatoms, C and N isotopes, sedimentology and macro-charcoal are applied on sediment cores to reconstruct centennial to millennial scale vegetation, fire and climate variability in the province of Jambi. Currently, five sites are completed: Danau Njalau and Danau Bento from the submontane ecosystems of the Kerinci National Park; Jaw SPT, from the inland peatland of Air Hitam; Sungai Buluh from a coastal peatland restoration area and Mendahara Ilir from the mangrove coastline. Five additional sites were cored to be studied including a site internal to the plot HFr2 (Figure1).

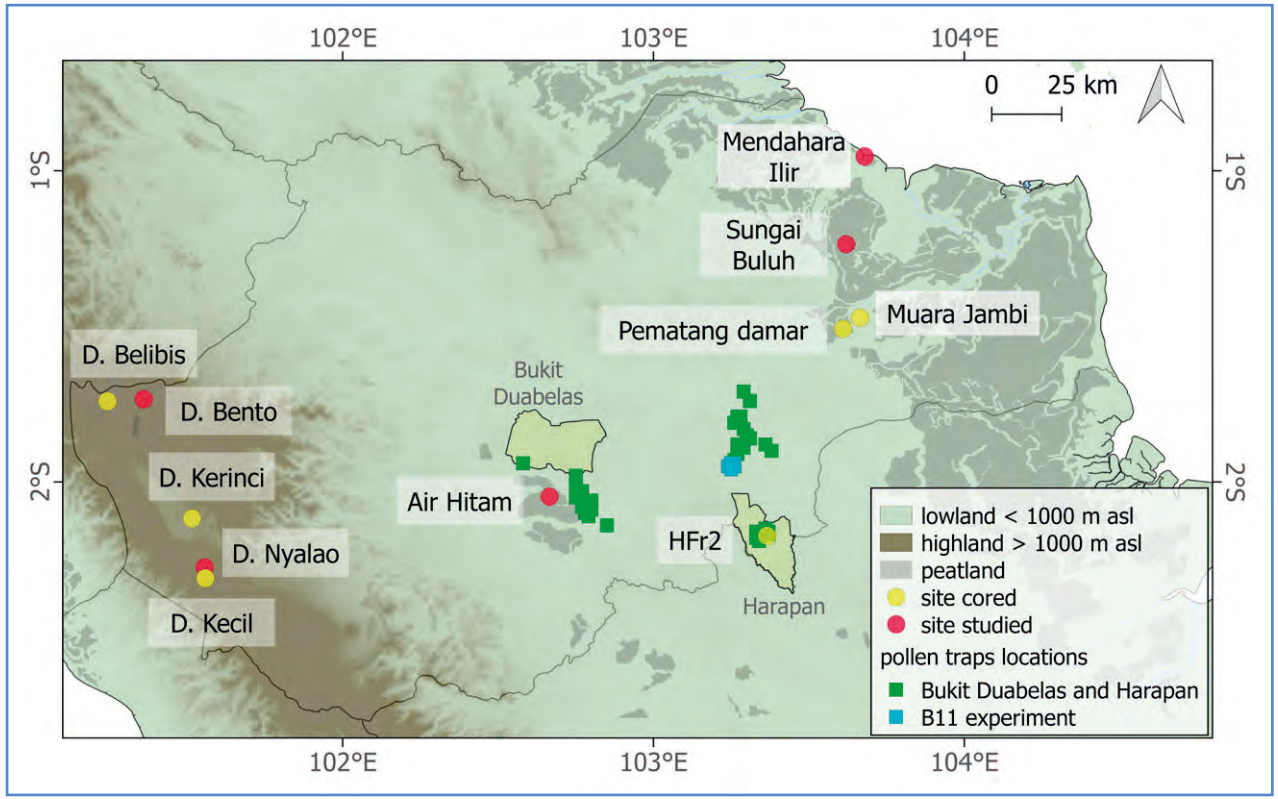


Figure 1: Map of the locations of the coring sites and pollen traps in A01.

Photo 11: Team of A01 at work coring a lake. From right: Erik Suwananda (assistant, UNJA), Hermann Behling (PI, UGoe) and Septriono Hari Nugroho (collaborator).

The palaeoecological results from the Danau Njalau and Sungai Buluh core are now published. The analysis of Mendahara Ilir core has just been completed. Preliminary results show that in the past 2300 years mangrove forests rapidly moved inland or expanded seaward adapting to changes in sea-level. This suggests that under natural conditions mangroves in Jambi are resilient to sea-level changes of the magnitude expected in the future 100 year.

We have now collected pollen traps from the core plots for 4 consecutive year (2013-2016) including one El Niño year. The analysis of the pollen traps (ongoing) will provide a better understanding of the effect of climate on the phenology of plants in different land-use systems. We started monitoring pollen rain in the B11 experiment and the first year of pollen traps was collected in September. We continue our collaboration with B09 on plant-pollinator interactions in the core plots and new riparian plots. Sampling is ongoing.

A02

TITLE: **Tree and palm water use**

TEAM: Principal Investigators: Dirk Hölscher (UGoe); Herdhata Agusta Hendrayanto (IPB).
Scientific Staff: Florian Ellsäßer (Doctoral Researcher).
Associated Scientists: Alexander Röll (Postdoctoral Researcher), Joyson Ahongshangbam (Doctoral Researcher).

RESEARCH SUMMARY:

Rainforest transformation alters ecosystem water cycles with respect to the magnitude of fluxes, their spatial heterogeneity and their temporal variability. In the first study period, the focus was on mean stand transpiration rates in forests, jungle rubber and rubber and oil palm monocultures. In the second study period, we address the spatial and temporal variability in plant water use across sites as well as mechanisms controlling tree and palm water use. The methods include different sap flux techniques and an airborne screening of canopy leaf temperatures.

Forests, oil palm and rubber plantations encompass heterogeneous site conditions. In periods of high rainfall, plants in valleys and at riparian sites are more prone to flooding than plants at elevated topographic positions. To assess effects of topography and flooding on palm and tree water use, we first used sap flux techniques in oil palm and rubber plantations. Topographic position and flooding affected water use patterns in both oil palms and rubber trees, but the changes in rubber trees were much more pronounced: compared to non-flooded upland sites, the different flooding conditions at valley sites amplified the observed heterogeneity of mean plot water use by a factor of 2.4 in oil palm and by a factor of 4.2 in rubber plantations (Hardanto et al. 2017). In the forest, data was gathered with a similar approach and is subject to further processing and analysis.

Canopy leaf surface temperature patterns were assessed by using drone-based cameras. Here we aim at deriving a plant water stress index. We started a joint campaign (with B04) at the biodiversity enrichment experiment in which tree and palm leaf stomatal conductances, sap flux and canopy leaf temperatures were measured simultaneously. A second campaign at the biodiversity enrichment experiment site (together with B11 and A03) addressed thermal heterogeneity over a larger area, i. e. the tree islands in a sea of oil palms. Extensive campaigns were also conducted in the Harapan forest (see Figure 2), partly simultaneously with the above mentioned sap flux measurements, and at the eddy tower site in the PTPN VI oil palm plantation with A03.

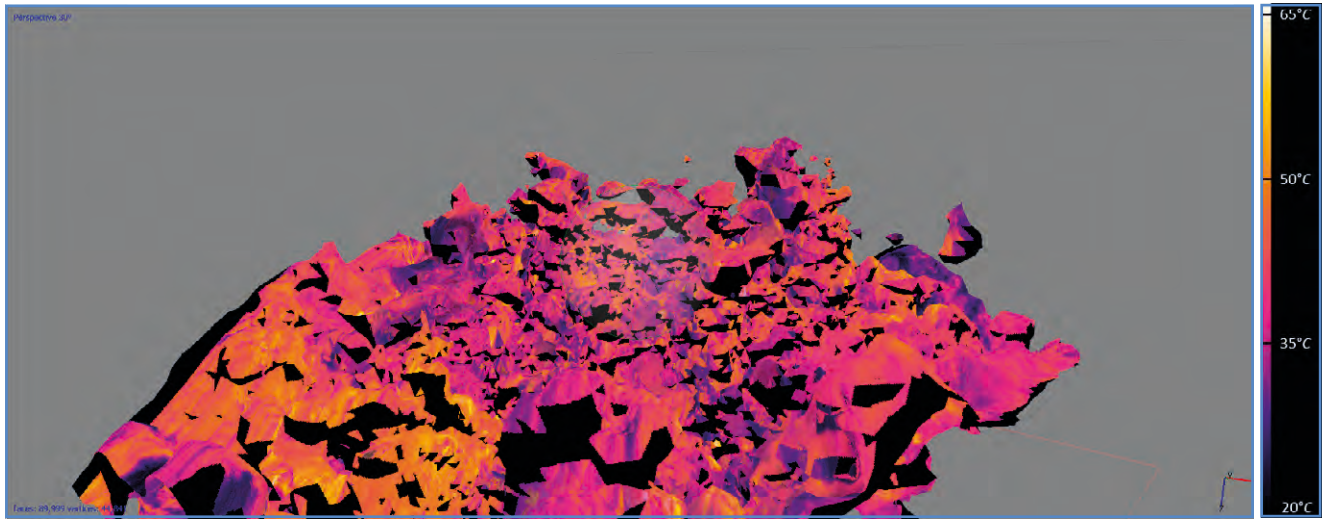


Figure 2: Three-dimensional thermal heterogeneity of the rainforest canopy (plot HF1 and immediate surroundings, 18 November 2016, 12.00 h) (Ellsäßer et al., unpublished data).

A03

TITLE: **Ecosystem-scale assessment of the full greenhouse gas and energy balance of an oil palm plantation in Sumatra (Indonesia)**

TEAM: Principal Investigators: Alexander Knohl, (UGoe), Tania June (IPB), Dodo Gunawan (Badan Meteorologi Klimatologi dan Geofisika, Indonesia, BMKG), Abdul Rauf (University of Tadulako, UNTAD).
Scientific Staff: Christian Stiegler (Postdoctoral Researcher).
Associated Scientists: Fernando Moyano (Postdoctoral Researcher), Mattia Bonazza, Clifton Sabajo (Doctoral Researchers.)
Technical Staff: Malte Puhan, Edgar Tunsch.

RESEARCH SUMMARY:

We investigated the impact of the 2015-2016 El Niño – Southern Oscillation (ENSO) event on greenhouse gas exchange and surface energy budget at PTPN6 oil palm plantation. The 2015-2016 ENSO was one of the strongest observed in the last 20 years. At PTPN6 oil palm plantation we observed dry conditions during the period 1 May to 31 October, with accumulated precipitation of only 400 mm, while accumulated precipitation for the entire year 2015 was 1930.5 mm (Figure 3). The dry conditions favoured forest and peat fires. Fire intensity peaked during the period September to November 2015 and covered vast areas of Southeast Asia, including Jambi province, under dense haze and smoke. With increasing haze, the oil palm plantation received decreasing amounts of photosynthetically active radiation (*PAR*). During the peak of the haze during mid-September to

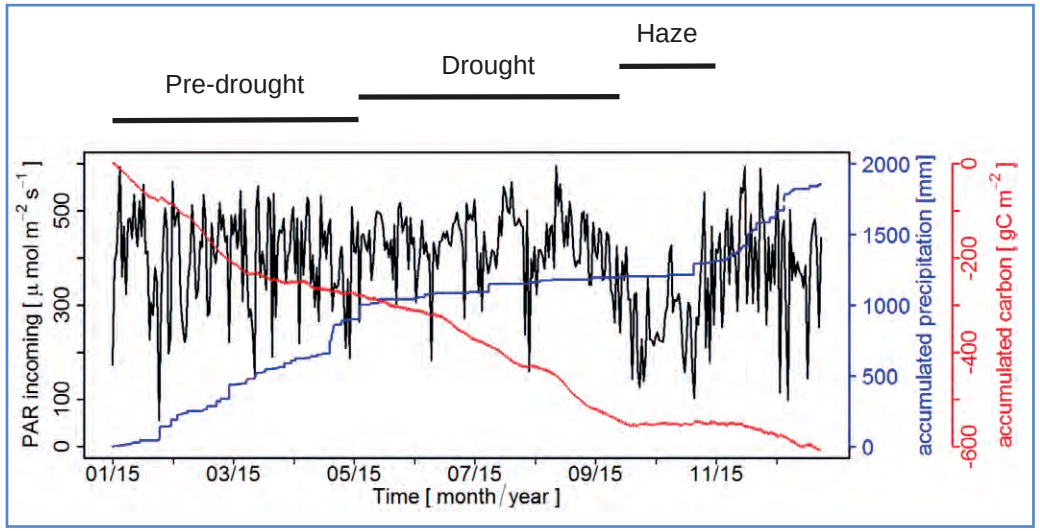


Figure 3: Incoming photosynthetically active radiation (*PAR*), accumulated precipitation and accumulated carbon during 2015.

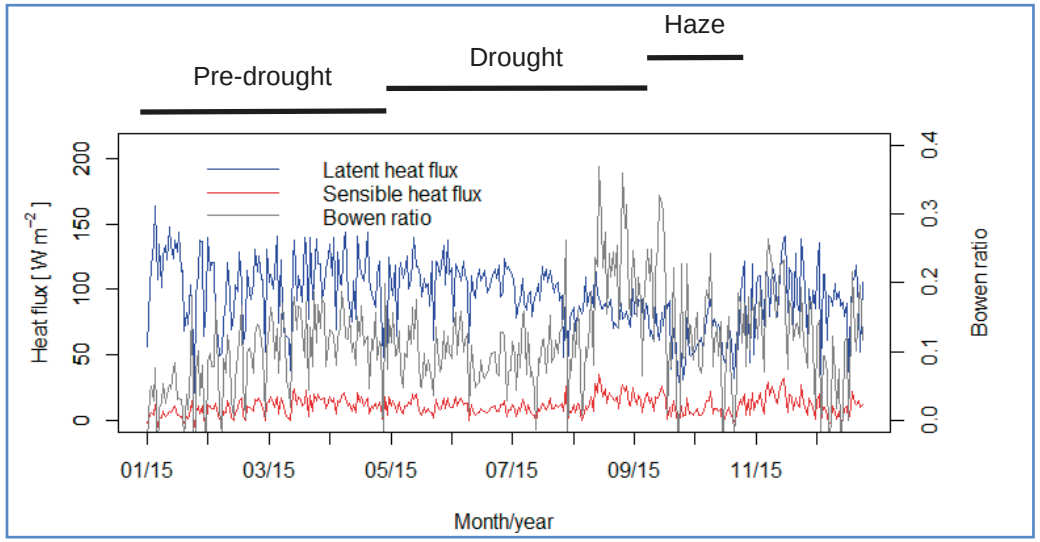


Figure 4: Daily average latent heat flux, sensible heat flux and Bowen ratio during 2015.

end of October 2015 average daytime incoming *PAR* was 519 µmol m^{-2} s^{-1} while for the rest of 2015 average daytime incoming *PAR* was 773 µmol m^{-2} s^{-1}. Accumulated carbon from net ecosystem exchange at the oil palm plantation is in good agreement with the overall behaviour of incoming *PAR* (R^2=0.60). Initially, drought conditions had little impact on carbon uptake by the oil palm plantation from the atmosphere and carbon uptake remained high until mid-September (Figure 3). However, carbon uptake stops abruptly in mid-September 2015 and during the peak of the haze the oil palm plantation turned into a small source of carbon to the atmosphere for almost two months. In addition, turbulent heat fluxes showed a strong response to drought and haze conditions (Figure 4). The drought increased sensible heat flux (*H*) at the cost of latent heat flux (*LE*). This is also reflected in the ratio of *H* to *LE* (Bowen ratio), which increased during the peak of the drought (Figure 4). The haze reduced the strength of the turbulent heat fluxes by 45 % compared to pre-haze conditions due to the reduction in available energy. In a next step we will use these results and perform the CLM-Palm model to test different scenarios of haze and drought and their effect on carbon, energy and water fluxes in the oil palm plantation.

A04

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

TEAM: Principal Investigators: Yakov Kuzyakov, Michaela Dippold (UGoe), Muhammad Damris (UNJA), Kukuh Murtilaksono (IPB).
Scientific Staff: Nina Hennings (Doctoral Researcher).
Asscociated Scientists: Thomas Guillaume (Postdoctoral Researcher).

RESEARCH SUMMARY:

During Phase 2, A04 focuses on soil characteristics and soil carbon (C) storage of riparian sites. We hypothesize:

1) Soils in riparian areas have higher C stocks compared to well-drained mineral soils
2) The conversion of forest to plantations has a more negative impact on C stocks of riparian soils compared to well-drained mineral soils, as carbon is less easily decomposed under water-saturated conditions
3) Water influence and fluvial mass transportation have an enhancing effect on C stocks.

In the summer of 2016 we sampled all riparian sites and did analyses for carbon and nitrogen content as well as stable isotopes ($^{13}C/^{12}C$ and $^{15}N/^{14}N$). Furthermore, a complete soil description was done for 12 profiles. Carbon stocks and losses were calculated and compared with first phase results from well-drained mineral soils. Carbon stocks in the forest were about 20 % higher in riparian soils than in well-drained mineral soils. In riparian rubber and soil plantations, C stocks were around 6 and 4 % higher than in the corresponding well-drained plantations. This has to be explained by higher bulk density values, but not by necessarily higher carbon contents. While significant differences were detected between forests and plantations in mineral soils, there were no significant differences between forest and plantations on riparian plots (Figure 5).

Furthermore, we found highly variable soils in the riparian forest, e. g. buried black layers (Photo 12) and half bog conditions in the topsoil, that influence the carbon content and stable isotope distribution with depth. While $\delta^{13}C$ in well-drained mineral soils increased monotonically with depth, this pattern could not be found in riparian soils. The zigzag pattern can be explained by anaerobic conditions that may hamper the decomposition of soil organic carbon (SOC) as well as a more complex pedogenetic development than in well-drained soils (Figure 6).

Moreover, A04 joins a collaboration with C08 where three different treatments on oil palm plantations and their effect on soil fertility and oil palm yields are compared (see C08). The research aim, apart from linking SOC contents to oil palm productivity, is to gain knowledge about critical limits of soil fertility indicators and their effect on crop yields.

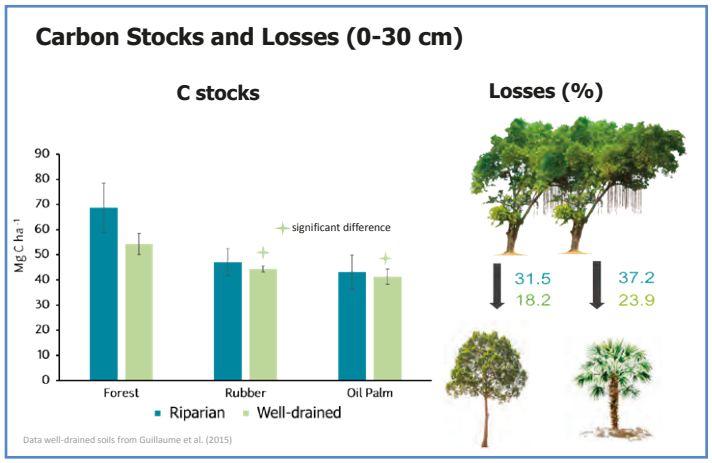


Figure 5: Carbon Stocks and Losses.

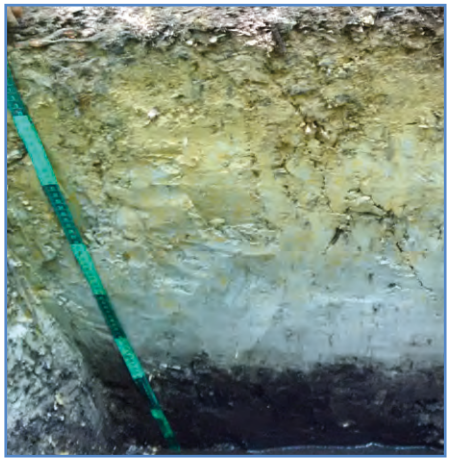


Photo. 12: Soil Profile of HFr2: clearly visible buried black layer.

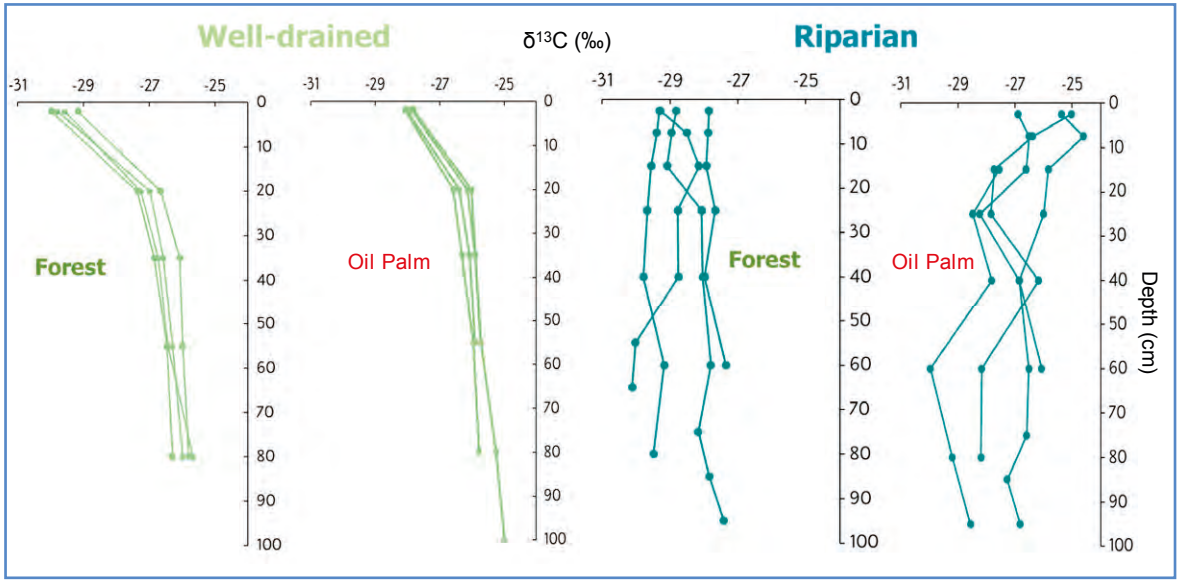


Figure 6: Isotope composition in riparian and well-drained soils: riparian specific soil conditions affect $\delta^{13}C$ depth distribution.

A05

TITLE: **Ground soil nitrogen oxide fluxes from forest conversion to smallholder oil palm and rubber plantations and oil palm canopy soil nitrous oxide and methane fluxes**

TEAM: Principal Investigators: Marife D. Corre, Edzo Veldkamp (UGoe); Muhammad Damris (UNJA); Sri Rahayu Utami (University of Brawijaya – UB); Aiyen Tjoa (UNTAD).
Scientific Staff: Greta Formaglio, Joost Koks (Doctoral Researchers).
Asscociated Scientists: Syaruhl Kurniawan (Postdoctoral Researcher).

RESEARCH SUMMARY:

Forest conversion is known to influence ground soil nitrous oxide (N_2O) and nitric oxide (NO) fluxes. Nevertheless measurements from oil palm and rubber plantations are scarce (for N_2O) or nonexistent (for NO). Also, oil palm canopy soil, organic material lodged between the leaf bases and stem of oil palms, has not been investigated for its contribution to trace gas fluxes (Figure 7). Thus, in this study we aimed 1) to quantify changes in ground soil-atmosphere fluxes of Noxides with forest conversion to smallholder rubber and oil palm plantations and to quantify N_2O and methane (CH_4) fluxes from oil palm canopy soil; and 2) to determine the controlling factors of ground and

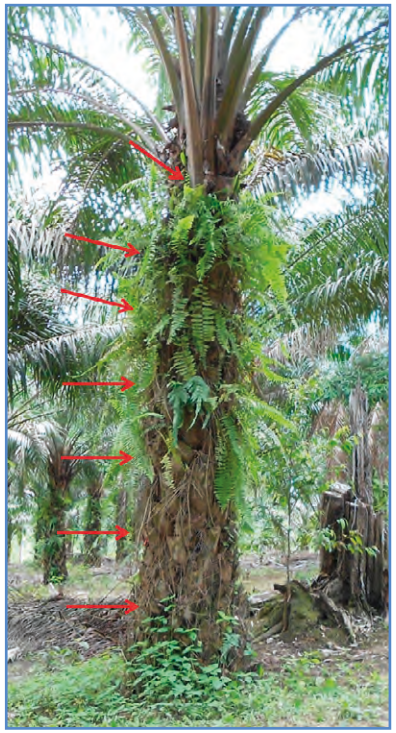


Figure 7: Parts of the stem where canopy soil in oil palm is lodged.

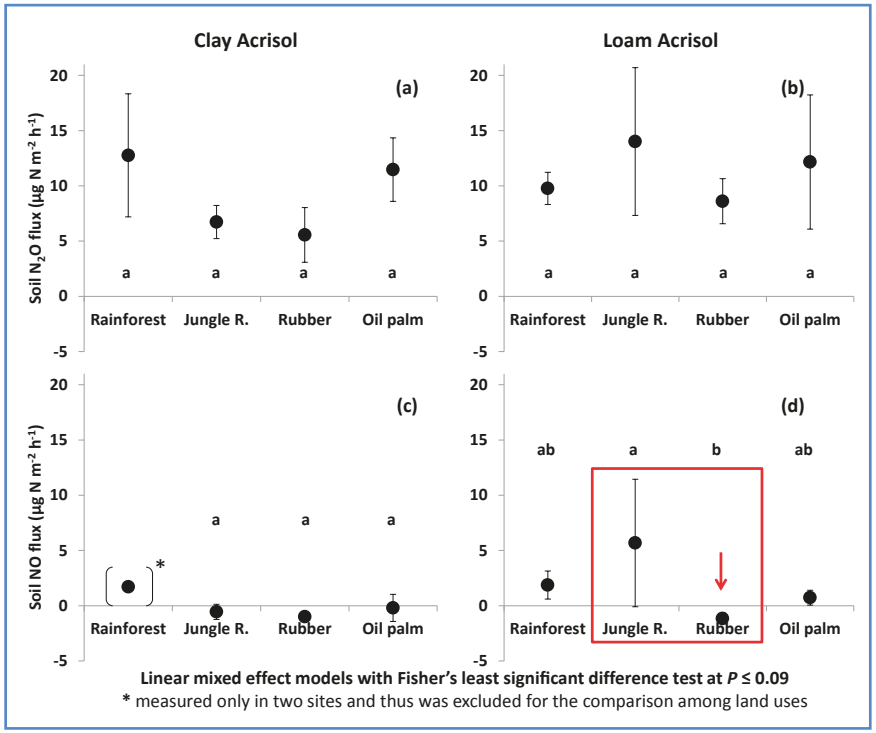


Figure 8: Mean (± *SE*, *n* = *4* sites) soil N_2O and NO fluxes from forest, jungle rubber, rubber and oil palm, located within the clay (Bukit duabelas) (**a and c**) and loam Acrisol (Harapan) (**b and d**) landscapes in Jambi, Sumatra, Indonesia.

canopy soil greenhouse gas fluxes. Our study showed that forest conversion to smallholder plantations had no effect on ground soil N-oxide fluxes ($P = 0.58$ to 0.76) due to the generally low soil N availability in the reference land uses of these highly weathered Acrisol soils that further decreased with land-use conversion (Figure 8). Nitrogen fertilization in smallholder oil palm plantations showed elevated ground soil N-oxide fluxes ($P < 0.01$-0.03), but this effect only lasted at most two month following fertilization. Together with the small area of such banded fertilization application, this pulse N fertilization effects only contributed 6-21% of the annual flux. Notable was also the lower ground soil NO fluxes from rubber than from jungle rubber in the loam Acrisol soil (Harapan) ($P = 0.07$) (Figure 8). This was because of the low water-filled pore space and the higher soil NO_3^- contents in jungle rubber, which could favor soil NO emission from the latter. The low soil NO fluxes from rubber plantations could also be the result of the effect of monoterpenes, produced by rubber trees, which reduce nitrification in soil. The temporal patterns of soil N-oxide fluxes were largely influenced by soil mineral N and water contents. On the other hand, oil palm canopy soil showed large N_2O and CH_4 fluxes on soil mass basis, but because the total canopy soil mass on a hectare basis was low, the overall contribution of canopy soil greenhouse gas fluxes became low. Annual oil palm canopy soil N_2O and CH_4 emissions were 10.7 ± 3.3 g N_2O-N ha^{-1} yr^{-1} and 1.9 ± 0.5 g CH_4-C ha^{-1} yr^{-1}, respectively, which contributed only 1 % of the total soil (canopy soil + ground soil) N_2O fluxes and 0.2 % of the ground soil net CH_4 consumption. Nevertheless, considering the increasing areal coverage of oil palm plantations in Southeast Asia, these fluxes could have substantial contribution to soil greenhouse gas budgets in areas which are more humid, which have higher dust accumulation and higher fertilization rates than the smallholders.

A07

TITLE: **Modelling biogeochemical processes in rainforest transformation systems in Sumatra (Indonesia)**

TEAM: Principal Investigators: Alexander Knohl, Edzo Veldkamp (UGoe); Tania June, Surya Tarigan (IPB).
Scientific Staff: Ashehad Ali (Postdoctoral Researcher).
Associated Scientists: Yuanchao Fan, Fernando Moyano (Postdoctoral Researchers), Rahmi Ariani (Doctoral Researcher).

RESEARCH SUMMARY:

A major part of the landscape in Jambi province is covered by rubber plantations. It still remains unclear however whether the rubber plantations would act as a carbon sink or whether their water use would be as high as anticipated. Understanding these processes are crucial because land use changes to rubber plantations may have important implications for carbon and water balances. Here, we developed a rubber plant functional type in the Community Land Model (version 4.5) and explored various plant growth hypotheses for rubber plants by implementing three assumptions in the model. Firstly, we assumed that a similar proportion of transfer of storage carbon and nitrogen from transfer pools to displayed pools during the wet and dry season (evergreen phenology). Secondly, we assumed that plants are adapted to the dry season and so there is only little transfer of storage carbon and nitrogen from transfer pools to displayed pools during the dry season (drought deciduous phenology). Our final assumption involved prescribing the leaf emergence and defoliation based on the observational dates (prescribed phenology).

We found that the rubber plantation was a source of carbon (Net Ecosystem Exchange (NEE); NEE < 0) until rubber was mature while the planation became carbon sink (NEE > 0) during the maturity phase (Figure 9). All of the hypotheses resulted in similar values of NEE prior to rubber maturity (Figure 9). During the rubber maturity phase, NEE varied moderately among the various hypotheses, where the evergreen phenology resulted in the highest carbon uptake with the drought deciduous being the least (Figure 9). Transpiration tended to be low during the initial growth phase of the rubber plants and seemed to reach some peak during maturity (Figure 10). These findings were similar across the hypotheses with the evergreen having the most water

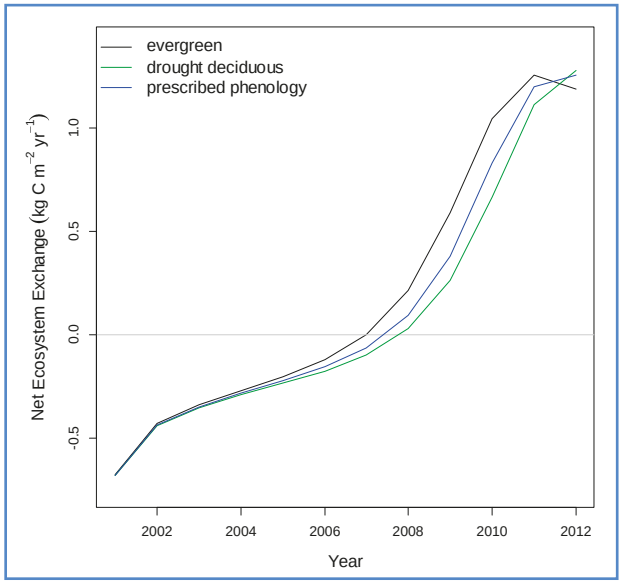


Figure 9: Annual trends of Net Ecosystem Exchange (defined as carbon uptake less carbon release) predicted under different rubber growth hypotheses (evergreen; black line, drought deciduous; green line and prescribed phenology; blue line).

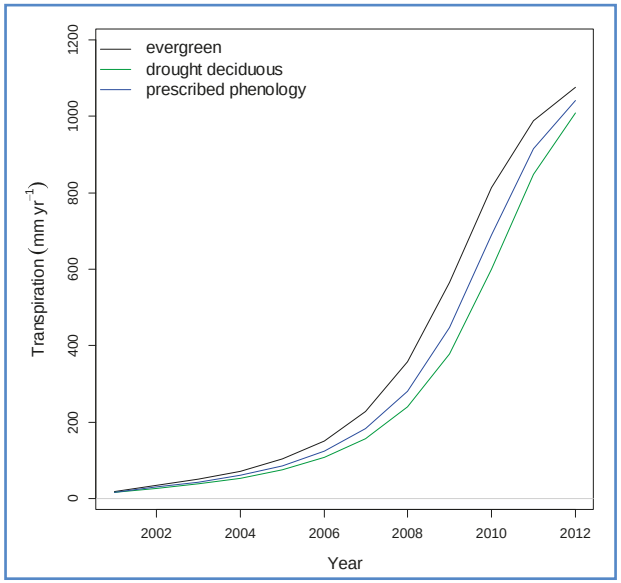


Figure 10: Yearly water loss from rubber plants (Transpiration) predicted under different rubber growth hypotheses (evergreen; black line, drought deciduous; green line and prescribed phenology; blue line).

loss during maturity and the drought deciduous being the least (Figure 10). The magnitude of NEE and water loss varied markedly during the maturity period among the alternative hypotheses indicating that greater effort is needed to develop the additional processes in the model that would help understand the variation of NEE and water loss when the rubber matures. Our results also suggest that carbon and water fluxes of rubber plantations are highly dependent on its growth phase.

Group B

FIELDS OF RESEARCH
- Biota and ecosystem services

GROUP COORDINATORS
Teja Tscharntke, Holger Kreft (UGoe);
Leti Sundawati (IPB);
Upik Yelianti (UNJA)

REPRESENTATIVES OF DOCTORAL/ POSTDOCTORAL RESEARCHERS
Kira Urban (B05)

B02

TITLE: **How rainforest conversion to agricultural systems on Sumatra (Indonesia) affects active bacterial communities in soil**

TEAM: Principal Investigators: Rolf Daniel (UGoe); Anja Meryandini, Nisa Rachmania Mubarik, Iman Rusmana (IPB); Zulkarnain (UNJA).
Scientific Staff: Dirk Berkelmann (Doctoral Researcher).

RESEARCH SUMMARY:

Prokaryotes are the most abundant and diverse group of microorganisms in soil and mediate virtually all biogeochemical cycles in terrestrial ecosystems. In Phase 2 of the scientific project, we aim to analyse entire and active prokaryotic communities regarding rainforest conversion, enrichment of biodiversity and different management systems in oil palm cultures. Sampling took place in May 2017 on all available plots (Photo 13). Subsequently, we already studied the effect of rainforest conversion on active bacterial communities in a RNA based study using 16S rRNA transcripts. Active communities were dominated by *Frankiales (Actinobacteria)*, Subgroup 2 of the *Acidobacteria* and *Alphaproteobacteria* (mainly *Rhizobiales* and *Rhodospirillales*) and showed significant differences in community composition between agricultural sites compared to rainforest reference sites (see Figure 11). Most

important abiotic drivers for community formation were pH, Ca, base saturation and C to N ratio (see Figure 12). Co-occurrence networks showed decreased clustering of OTUs and an increase of positive correlations, suggesting a decrease of competition of the active community in agricultural systems. Metabolic predictions based on 16S rRNA data revealed different patterns for oil palm and rubber related agricultural systems compared to rainforest samples. We could show that biological fixation of nitrogen, as well as nitrification and denitrification is significantly decreased in transformed systems, which can be linked to a decrease of typically nitrogen metabolism related groups like *Rhizobiales*. Additionally, bacterial interactions and antagonistic behaviour seemed to be reduced. We therefore concluded, that rainforest transformation and agricultural management in form of fertilizer application and liming led to a less dynamic active bacterial community, in which less competition for nutrients (due to higher availability by fertilization and liming) occurs and consequently antagonistic behaviour is reduced. Additionally, we assume that the observed effects of rainforest transformation on the active bacterial community are strongly depending on continuous agricultural management.

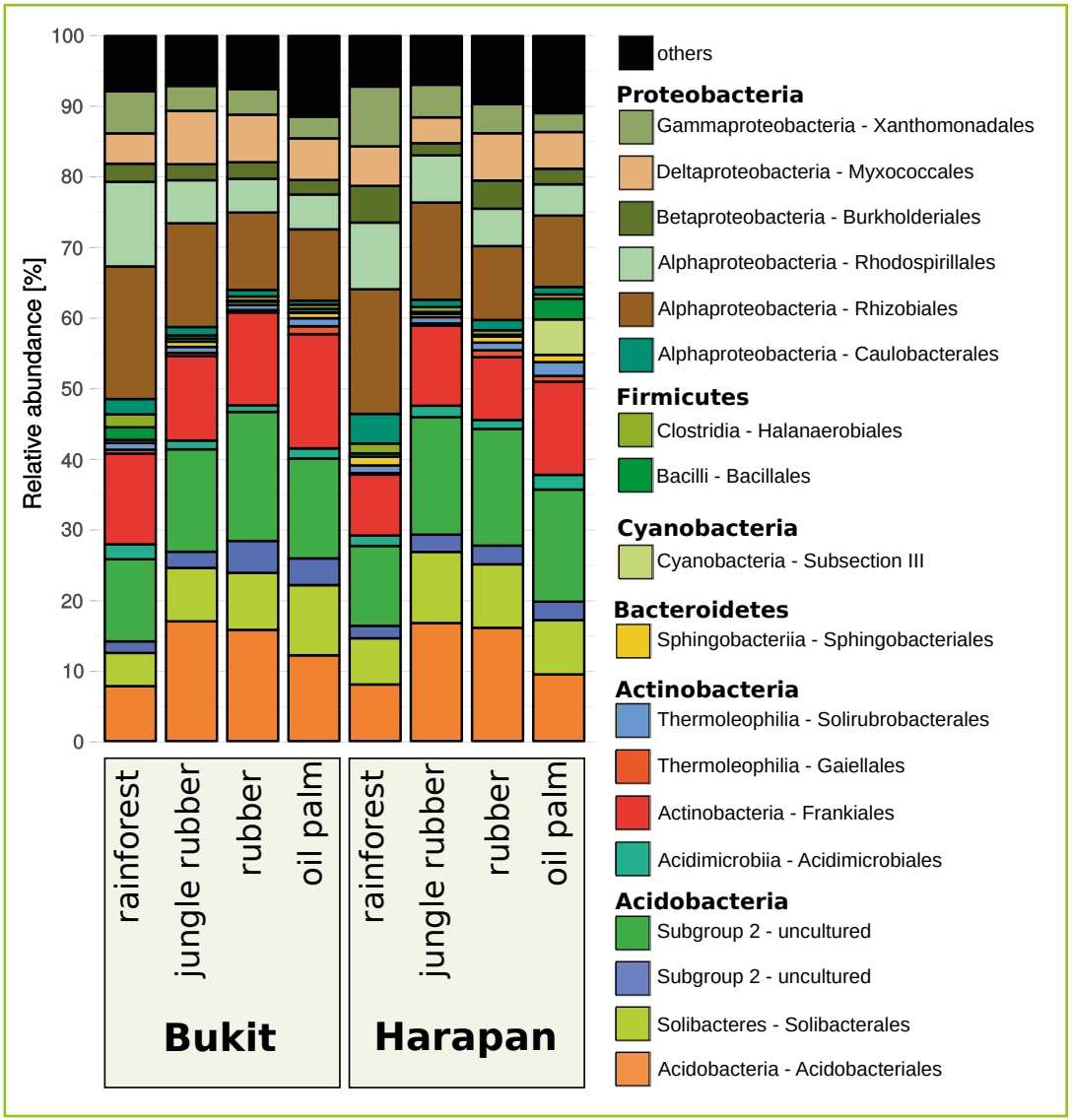


Figure 11: Active bacterial community composition at order level in each land use system in two separate landscapes. All OTUs with abundance >1% are summarized as „others".

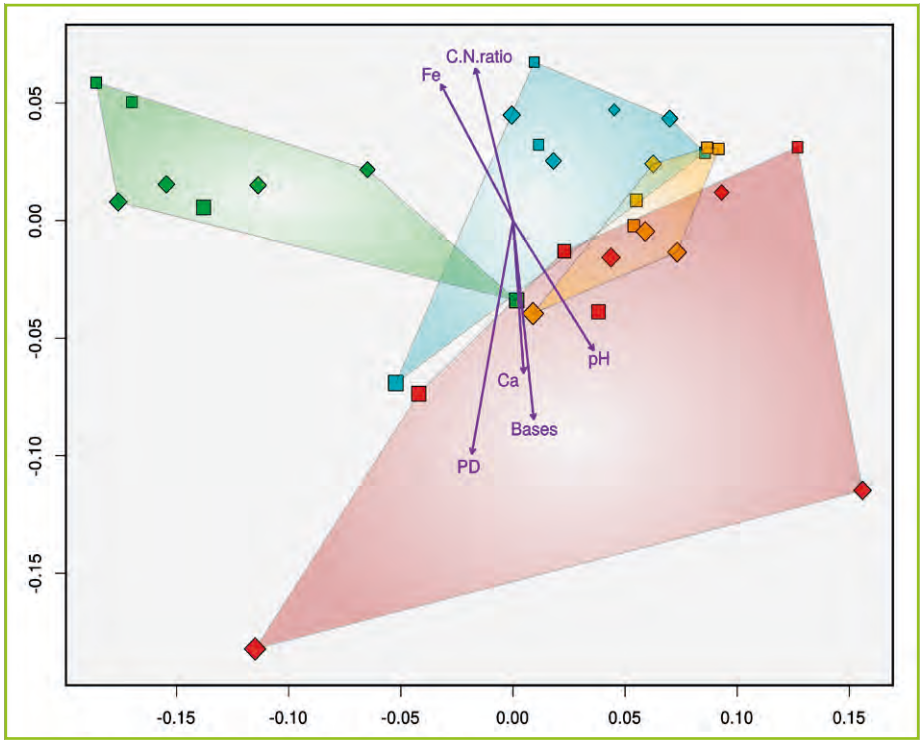


Figure 12: Non-metric multidimensional scaling (NMDS) based on a weighted Unifrac distance matrix.

Photo 13: B02 sampling in May 2017 in Jambi. From left to right: Zulfi Kamal, Dirk Berkelmann and Pak John.

B05

TITLE: **Land use patterns in Jambi - quantification of structure, heterogeneity and changes of vegetation and land use as a basis for the explanation of ecological and socioeconomic functions**

TEAM: Principal Investigators: Christoph Kleinn (UGoe); I Nengah Surati Jaya, Tatang Tiryana (IPB); Mohammad Zuhdi, Eva Achmed (UNJA).
Scientific Staff: Lutz Fehrmann (Postdoctoral Researcher); Kira Urban,
Associated Scientist: Edwine Setia Purnama (Doctoral Researcher).

RESEARCH SUMMARY:

We tested the suitability of the recently launched C-SAR satellite Sentinel-1 for detection of fire induced land cover changes. First preliminary results were published in Urban et al. (2016). The study showed general potential in the combination of Sentinel-1 and Google Earth Engine for land cover change detection with a high spatial and temporal resolution (Figure 13). However, misclassification caused by flooding and atmospheric conditions should be reduced using secondary data (e. g. FIRMS MODIS fire hotspots). In the ongoing research, we focus on near-real time detection and area estimation of burned areas as a basis for fire monitoring and management.
Furthermore, we conducted field sampling of forest structure characteristics with n=70 forest inventory plots and UAV flights in collaboration with PT. REKI (Photo 14). The goal is to investigate the potential of combining different sources of information, optical and radar imageries with on-site measurements, to relate indicators of forest structure, that can be observed by remote sensing – to canopy surface roughness.
Moreover, resulting from a successfully extended proposal to the RapidEye Science Archive (RESA) of German Aerospace Center (DLR), we received follow up RapidEye images for the study area of EFForTS for 2015. These images are used to update the RapidEye classification of 2013 produced during the first phase.
Ongoing collaborations with C07 and B09 are looking into the influence of spatial pattern on land titling and rural development as well as on species occurrence.

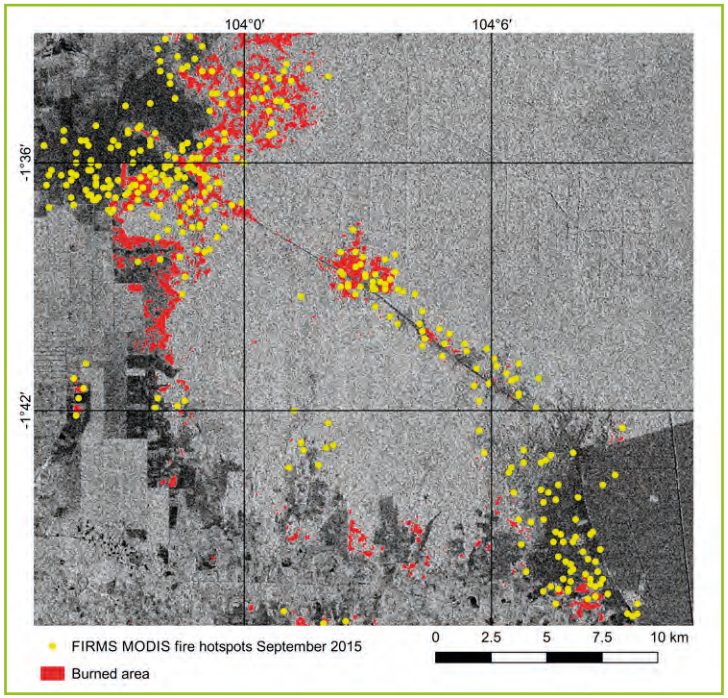


Figure 13: Burned area mapping based on FIRMS MODIS fire hotspots (yellow dots) and on Sentinel-1 (red).

Photo 14: Forest Inventory by B05 (from left to right: Fahrurrozi, Erwin Pranata Sakti, Juwita Sri Maranatha, Kira Urban).

B06

Photo 15: B06 field team on the way to Plot HFr4 during a flooding event after heavy rain (from left to right: Ihsan, Edo, Katja, Juwita, Vive, Ojan).

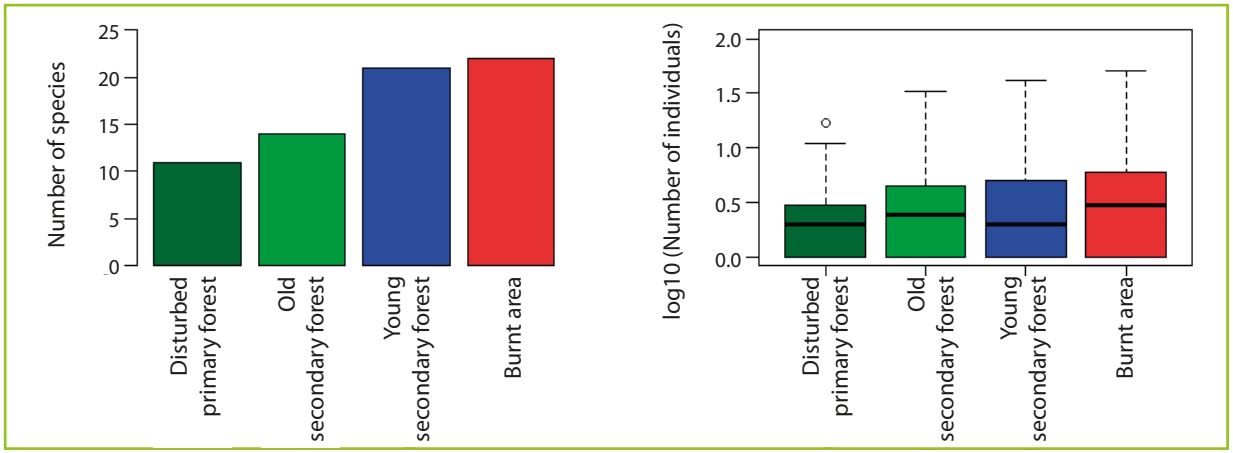


Figure 14: Total number of invasive alien plant species in each forest type (a) and logarithmic transformed number of invasive alien plant individuals per forest type (b).

TITLE: **Taxonomic, phylogenetic, functional, and biogeographical diversity of vascular plants in rainforest transformation systems on Sumatra (Indonesia)**

TEAM: Principal Investigators: Holger Kreft (UGoe); Sri Sudarmiyati Tjitrosoedirdjo (IPB); Bambang Hariyadi (UNJA).
Scientific Staff: Katja Rembold (Postdoctoral Researcher).

RESEARCH SUMMARY:

In the scientific project B06, we investigate different dimensions of plant diversity to assess the effects of land-use changes on plant diversity and key structural parameters. The results from our vegetation surveys on 32 well-drained core plots during the first project phase have now been published (Rembold et al., 2017). In total, we recorded 156,006 individuals and 1,382 vascular plant species. Forest had the highest levels of alpha, beta, and gamma diversity, followed by jungle rubber. Plant communities in oil palm plantations were characterized by a high density of herbaceous weeds, but low species numbers and low beta diversity. Species numbers were comparable in oil palm and rubber plantations, but the latter showed slightly higher beta diversity. Forest had a clearly distinct floristic composition while the other systems – and especially the two plantation systems – converged in species composition. Alien species were almost completely absent from forest, but the number and relative abundance of alien species increased with increasing land-use intensity and was highest in oil palm plantations where 25 % of the species and 62 % of the individuals belonged to alien species.

Vegetation surveys on the 12 new riparian core plots are on-going (Photo 15), but the 8 plots outside the forest were already completed in 2016. During the vegetation surveys, we already collected 278 new barcoding samples from the riparian plots for scientific project Z02 (plant barcoding). Meanwhile, the plant barcoding team in Göttingen edits the nucleotide sequencing data which were already obtained during the first phase and prepares them for submission to the Barcode of Life Data (BOLD) (http://www.boldsystems.org) and the NCBI GenBank (https://www.ncbi.nlm.nih.gov) databases. Parallel to the vegetation surveys, we are collecting leaf traits from all 44 core plots to study functional plant diversity across the four land-use systems. The work on functional

plant diversity is carried out in close cooperation with scientific project B04.

The results from 3 master theses and one bachelor thesis on vascular epiphyte diversity in different land-use systems have been published in Böhnert et al. (2016). Two master projects have been completed during the second phase: Ms. Anu Singh worked on the effects of forest roads and forest degradation on invasive alien plant species and found that the number of invasive alien plant species decreased with increasing forest quality and increasing distance to roadsides (Figure 14). Mr. Kamal Raj Aryal investigated the effect of land-use change on the diversity of useful plants and while the distribution varied among the different use categories, the total number of useful species decreased with increasing management intensity with highest numbers in forest and lowest numbers in oil palm plantations (Figure 15a). Oil palm plantations however had the highest abundance of useful plants and forest the lowest (Figure 15b).

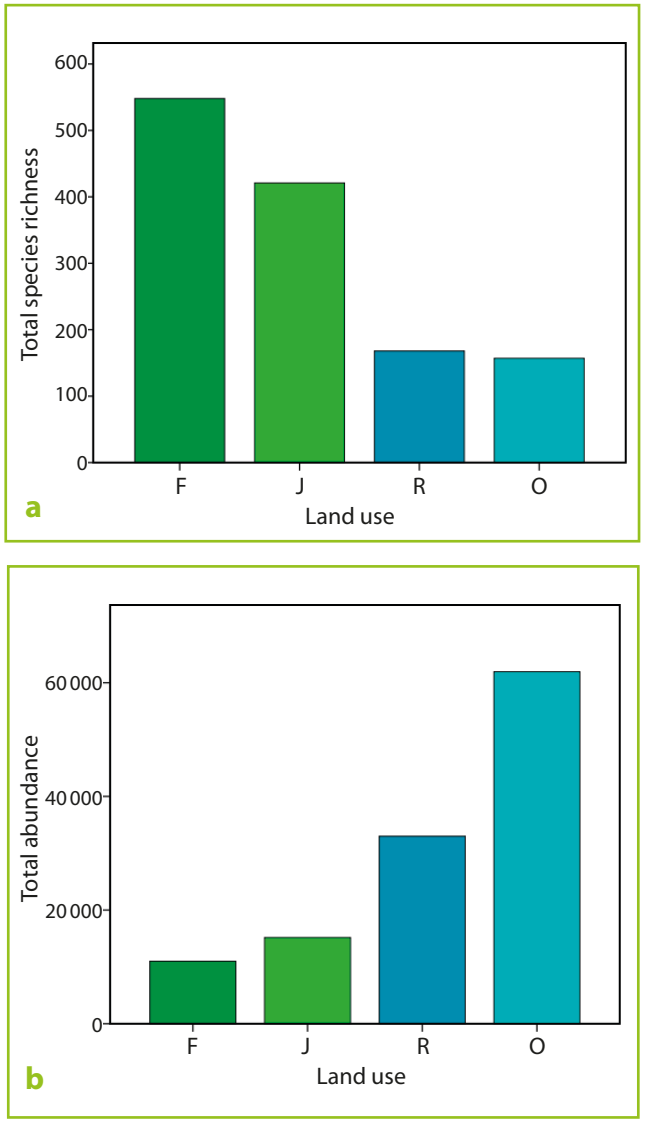


Figure 15: Total species richness (a), and Total abundance (b) of useful plant species across different categories in the four land-use systems: forest (F), jungle (J), rubber plantations (R), oil palm plantation (O).

B07

TITLE: **Impact of tropical land transformation on root and soil associated fungal communities**

TEAM: Principal Investigators: Andrea Polle (UGoe); Sri Wilarso Budi (IPB); Bambang Irawan, Upik Yelanti (UNJA); Henry Barus (UNTAD); Dewi Malia Prawirdilaga (LIPI).
Scientific Staff: Johannes Ballauff (Doctoral Researcher).
Associated Scientists: Nur Edy (Postdoctoral Researcher), Rachmawaty Aisjah Ryadin (Doctoral Researcher).

RESEARCH SUMMARY:

Aims: We are analyzing how fungal communities and fungal co-occurrence patterns are affected by land transformation, which environmental factors are mainly responsible for these shifts and how these community changes alter the functionality.

Current status:

- Fungal community of 264 root and soil samples from core and riparian plots was identified using Illumina sequencing.
- Root and soil samples were taken from all plots of the B11 enrichment experiment.
- Root vitality was accessed morphologically in all samples.

First results: Fungal species richness differed between plantation and forest sites. The composition of the distinct soil and root associated communities was strongly altered by land-use. We observed shifts in the abundance of functional groups and a decline of root health in plantation sites (Figure 16).

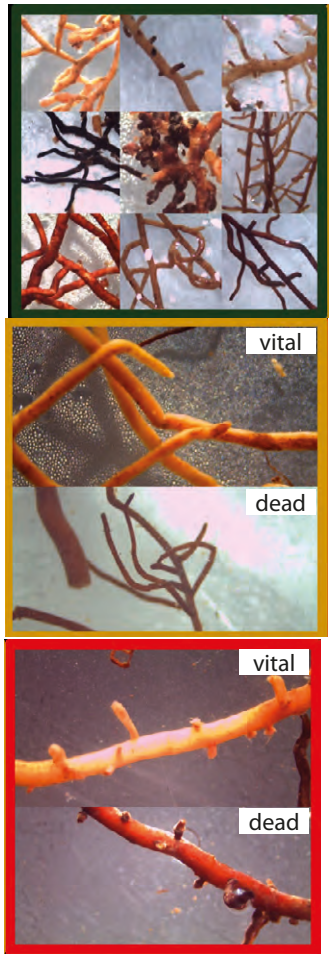


Figure 16: Image of root tips during vitality assessment: diverse root community from forest plot (green), roots from rubber (yellow) and oil palm (red).

B08

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

TEAM: Principal Investigators: Stefan Scheu (UGoe); Rahayu Widyastuti (IPB).
Scientific Staff: Anton Potapov, Valentyna Krashevska (Postdoctoral Researcher).
Associated Scientist: Dorothee Sandmann (Doctoral Researcher)

RESEARCH SUMMARY:

Aim: Evaluate the changes in soil fauna community structure and decomposer system functioning with conversion of rainforest into monoculture plantations.

Photo 16: Recent activities of the scientific project B08: (**1**) Sampling for soil macro- meso- and microfauna, microbial biomass, litter and soil stoichiometry from core and riparian sites, (**2**) Sampling for belowground/aboveground soil fauna, (**3**) Trenching experiment with root and litter exclusion, (**4**) Litterbags for measurements of litter decomposition in management experiment.

Status quo 2016-2017 (Photo 16):

- Sampling for soil macro- meso- and microfauna, microbial biomass, litter and soil stoichiometry from core and riparian sites was completed (**1**)
- Samples of belowground/aboveground soil fauna were taken in oil palm plantation (**2**)
- Trenching experiment with root and litter exclusion treatments was installed and sampled in Harapan landscape (**3**)
- Litter decomposition experiment (litterbags) was installed and sampled in the framework of the Management Experiment (**4**).

Litter decomposition was high in rainforest, low in rubber plantation and intermediate in jungle rubber and oil palm plantation (Figure17a). Microbial biomass decreased in jungle rubber, rubber and oil palm as compared to rainforest (Figure17b). Density of testate amoebae was high in rainforest and jungle rubber and decreased significantly in rubber and oil palm plantations (Figure17c). Overall, changing land-use from diverse forest systems

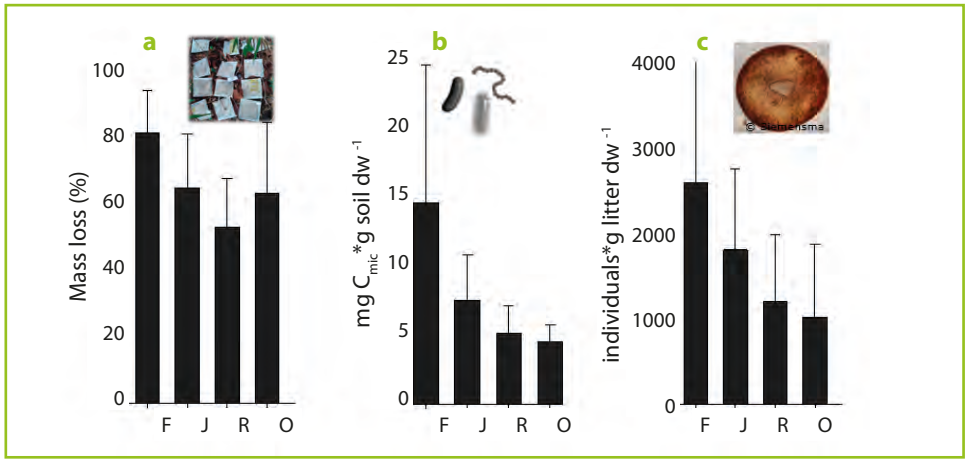


Figure 17: Litter decomposition after 12 months (mass loss %) (a); microbial biomass (b) and density of testate amoebae (c) in litter exposed in litterbags in four land-use systems: rainforest (R), jungle rubber (J), rubber (R) and oil palm (O); means and standard deviations (n = 8).

to monoculture plantations altered the chemistry of the system that shifts decomposer community structure and negatively affects essential ecosystem functions such as organic matter turnover.

Based on the animal collections from the first phase of the scientific project, the "Ecological Taxonomy" database was developed and is being filled (Photo 17). In the future, the database will serve as pictorial key for (morpho)species for various groups of the Indonesian soil fauna that will be easily accessible for scientists in Indonesia and all over the world.

Photo 17: Photo of female individual of the litter-dwelling spider *Scaphydysderina lubanako* (Oonopidae) for the database.

B09

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

TEAM: Principal Investigators: Teja Tscharntke, Ingo Grass (UGoe); Damayanti Buchori, Yeni Mulyani, Rika Raffiudin (IPB); Fuad Nurdiansyah (UNJA).
Scientific Staff: Kevin Darras (Postdoctoral Researcher), Kevin Li (Doctoral Researcher).

RESEARCH SUMMARY:

We have started to study insect pollinators in more detail. We will examine the effects of land transformation on pollinator community and pollination ecosystem services at the landscape, farm, and tree scale. One important quesiton is how tree enrichment in the B11 experiment affects the pollinator community and associated pollination network, as well as the spillover of these effects into the oil palm matrix. That work will be complemented by experimental phytometer plantings to track changes in pollination through chili pepper development. Additionally, we are completing a review of the literature on oil palm pollination.

Continuing the acoustic animal sampling work of the first phase, we have revealed the effects of land-use conversion on bird com-

munities of upland and riparian sites, and we are still analysing activity data for bat activity. We devised a new method for estimating bird distances in sound recordings and are now able to estimate bird density therein using distance sampling approaches. The work in acoustic monitoring methodology has resulted in three further manuscripts showing the potential of these modern methods for sonant animals sampling, which is superior to traditional bird point counts.

Our analysis of birds in the Berbak National park revealed that shrub bush, secondary forest and primary forest communities have similar levels of abundance, richness, and activity, except for a large shift in the identity of insectivorous birds (Timaliidae), which are missing from the more disturbed systems (Figure 18).

A large bird and bat mist netting campaign is ongoing in all Harapan core plots to elucidate the function of these animals through their diet, assessed via fecal droppings. Dr. Yeni Mulyani and Dr. Dewi Prawiradilaga also lead a mist-netting training for raising awareness about birds and building capacity of UNJA students (Photo 18).

A herpetological master study was completed with an intensive sampling survey which revealed that oil palm plantations, rubber plantations and forest sites had very different communities. Surprisingly, oil palm harbors high abundance levels in comparsion to dry forest sites.

Photo 18: Participants of the first bird mist netting workshop at UNJA, September to October 2017. From left to right: Supri Yadi & Ilham (staff members of B09), Muhammand Janra Nazri (University of Padang), Fransiska Noni (staff member of Dr. Yeni Mulyani, IPB), Novia Rahmawaty (staff member of B09).

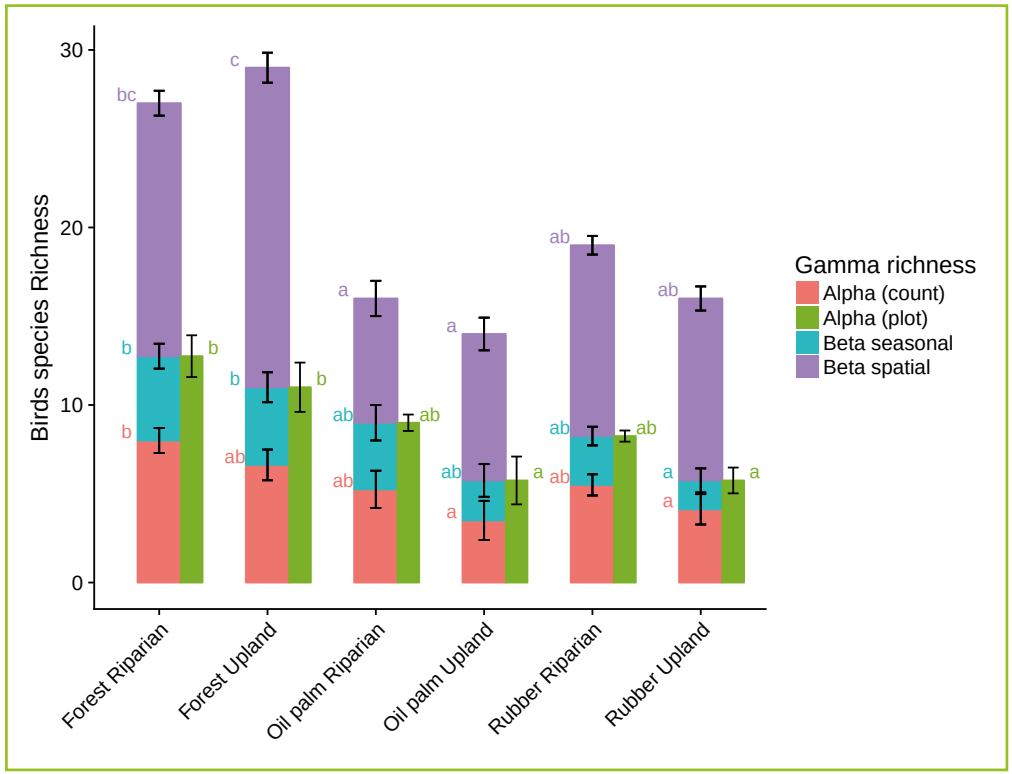


Figure 18: Total bird species richness per habitat (gamma), partitioned in mean count-level richness (alpha count) and mean plot-level richness (alpha plot).

B10

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

TEAM: Principal Investigators: Kerstin Wiegand (UGoe); Jann Lay (GIGA Hamburg); Surya Tarigan (IPB); Fuad Nurdiansyah, Sunarti, Maria Ulfa (UNJA).
Scientific Staff: Sebastian Renner, Jan Salecker (Postdoctoral Researchers).
Associated Scientists: Craig Simpkins (Postdoctoral Researcher).

RESEARCH SUMMARY:

Key part of the B10 scientific project is the development of EFForTS-ABM, an agent-based ecological-economic land-use change model with focus on smallholder oil palm and rubber farming. The economic submodel simulates smallholder land-use management decisions based on a profit maximization approach. Each household determines factor inputs for all household fields and decides about land-use change based on available wealth. The ecological submodels currently include a simple account of carbon sequestration in above-and below-ground vegetation. To integrate additional ecosystem functions and to extend the functionality of EFForTS-ABM, we currently develop a biodiversity submodel.

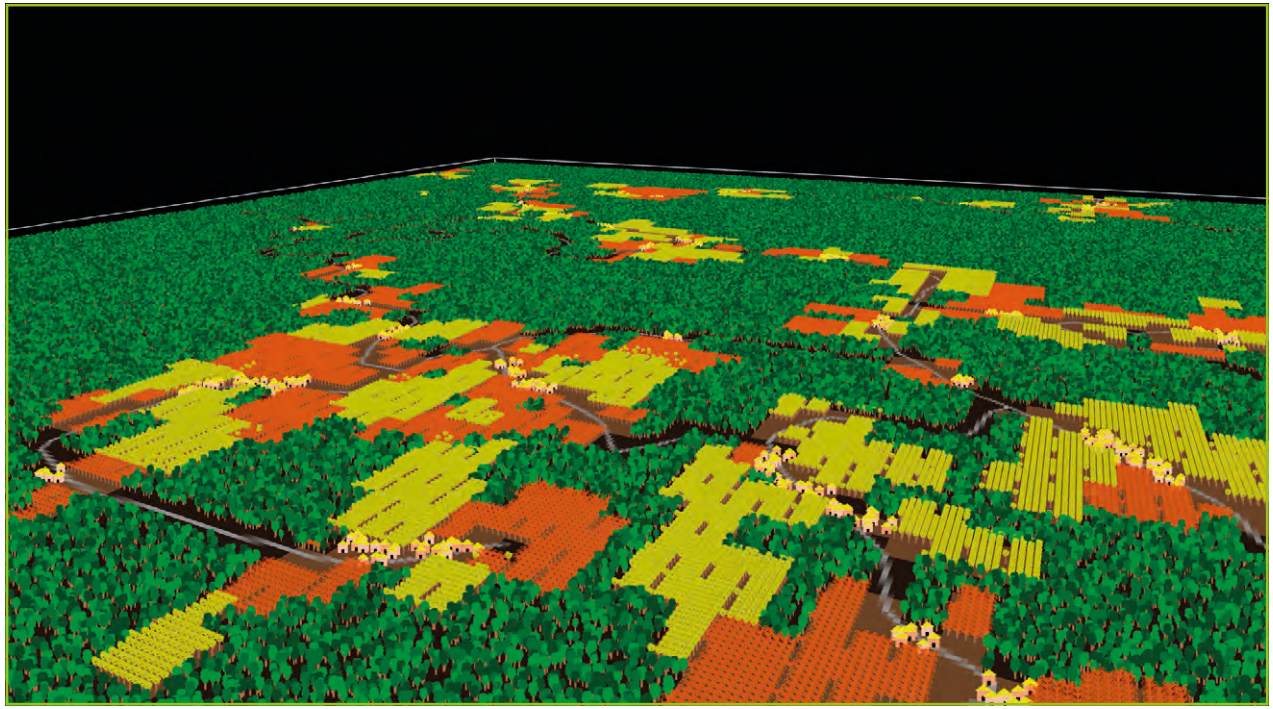


Figure 19: Snapshot of the EFForTS-ABM land-use change model showing a 3-dimensional representation of the model landscape. Grey lines represent roads; yellow house symbols represent household homebases; green areas represent secondary forest, yellow areas represent rubber plantations; orange areas represent oil palm plantations.

In order to study landscape configuration scenarios, we have developed a process-based landscape generator (EFForTS-LGraf) that creates maps of smallholder dominated agricultural landscapes which can be used as input for EFForTS-ABM (Figure 19).
In our recent model analyses we simulated different price dynamics and investigated the effect of heterogeneous production inefficiencies among smallholders. Overall results reveal complex interactions between the economic and ecological sphere. For instance, model scenarios with heterogeneous crop-specific household productivity reveal comparatively high inertia of land-use change and increased temporal stability in carbon stocks.
We are currently conducting an extensive sensitivity analysis to improve our understanding of model interactions and to increase model performance.

B13

TITLE: **Impact of management intensity and tree enrichment of oil palm plantations on below- and aboveground invertebrates in Sumatra (Indonesia)**

TEAM: Principal Investigators: Mark Maraun (UGoe); Noor Farikhah Haneda (IPB); Marsetyo (UNTAD).
Scientific Staff: Alena Krause (Doctoral Researcher).

RESEARCH SUMMARY:

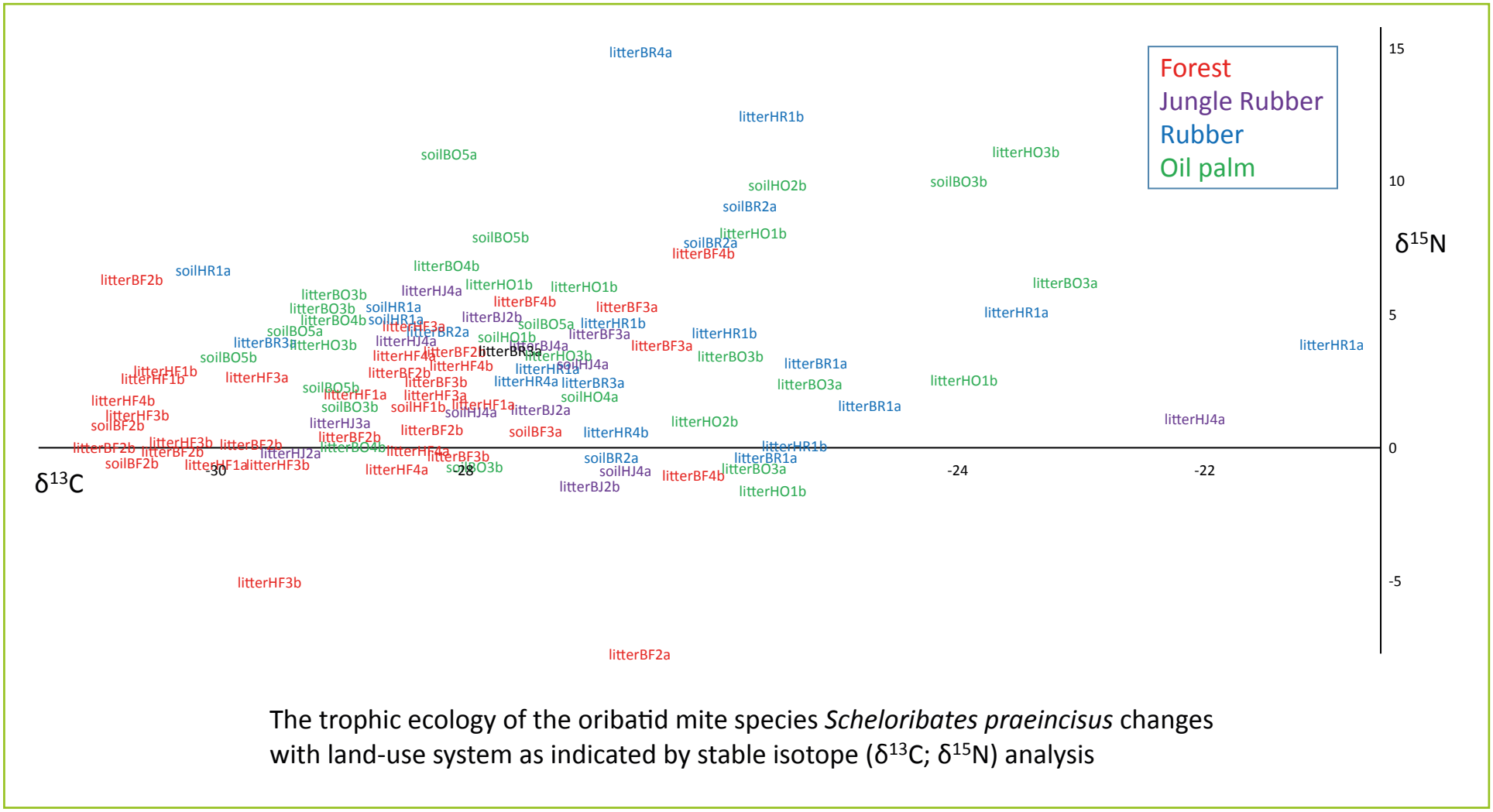
Tropical lowland rain forests in Sumatra (Indonesia) have been extensively converted into oil palm plantations. The effect of this conversion on the trophic ecology of above- and below-ground animals has been little studied.

Here, we investigated the effect of enrichment of oil palm plantations with native tree species on belowground invertebrate animal communities (in cooperation with B11) and their trophic ecology. We hypothesized that the enrichment of oil palm plantations with forest tree species increases density, diversity and complexity of belowground invertebrate communities. Soil samples were taken with spades (16 x 16 cm) from the Enrichment Experiment Sites in Humusindo (established in the first phase of EFForTS). For all 56 Plots we selected four replicates per plot. Overall we had 224 soil samples. Soil animals were extracted by heat using Kempson extractors, established at Jambi University in the first phase of CRC 990. Extracted animals were sorted according to their respective groups (collembolans, mites and other soil living animals) (Photo 20). Determination to family level was carried out with the help of bachelor and master students of UNJA and IPB University at UNJA University.

Additionally, stable isotopes (^{15}N; ^{13}C) of oribatid mites were measured. Samples were been taken in October and November 2013 from two study regions, i. e. Bukit Duabelas and Harapan landscape (Photo 19). Within these study regions four systems were investigated (rainforest, jungle rubber, rubber and oil palm). We choose oribatid mite species which occurred in all landscapes and booth regions. For one generalistic oribatid mite species, *Scheloribates praeincisus*, we found a high degree of trophic plastically which may be the reason for its widespread occurrence (Figure 20). More species are now being analysed with regard to their trophic plasticity.

Photo 19: Team of B13 at PT Humusindo (from left to right: Hanif Fataroh, Pak Arif, Marisi Italiansia, Alena Krause, Mohamad Suheri and Isabelle Arimond).

Photo 20: Assistants of B13 sorting soil samples into different soil groups (from left to right: Mohamad Suheri and Hanif Fataroh).



The trophic ecology of the oribatid mite species *Scheloribates praeincisus* changes with land-use system as indicated by stable isotope ($\delta^{13}C$; $\delta^{15}N$) analysis

Figure 20: Stable isotope (^{15}N; ^{13}C) data of *Scheloribates praeincisus* from the four land use types and the two landscapes Bukit Duabelas and Harapan.

Group C

FIELDS OF RESEARCH
- Human dimensions

GROUP COORDINATORS
Meike Wollni, Heiko Faust (UGoe);
Nunung Nuryartono (IPB);
Rosyani (UNJA)

REPRESENTATIVES OF DOCTORAL/ POSTDOCTORAL RESEARCHERS
Fenna Otten (C02)
Christoph Kubitza (C07)

C01

TITLE: **Smallholder efficiency**

TEAM: Principal Investigators: Bernhard Brümmer (UGoe); Rina Oktaviani, Dedi Budiman Hakim (IPB); Zulkifli Alamsyah, Mira Herlambang (UNJA).
Scientific Staff: Rakhma Sujarwo (Ella), Bernhard Dalheimer (Doctoral Researcher).
Associated Scientists: Thomas Kopp (Postdoctoral Researcher).

Photo 21: Auction market in Maju Jaya Village.

RESEARCH SUMMARY:

The environmental efficiency analysis has been extended from the examination of biodiversity indicators to the assessment of soil quality parameters. It has been found that degradation induced by land-use change has affected production. Firstly, farmers adjust fertilizer use in accordance with soil carbon (C) content and secondly, production on peat soil and degraded land exhibit substantially lower technical efficiency. Inefficiency effects in smallholder rubber production are marginally decreasing with the level of C-content up to a certain threshold, whereas technical efficiency in palm oil suffers linearly from C content in soils.

Both biodiversity indicators as well as soil quality parameters from the second round of data collection are now being compiled in order to assess the dynamics of environmental efficiency. Particular attention is paid to the determinants of efficiency changes over time. Furthermore, technical efficiency scores over time are estimated and their performance is evaluated. In both research focuses, the substantial differences in productivity and efficiency between transmigrant and autochthon farmers as well as their development over time are also of particular interest.

Market malfunctioning and efficiency

The market analysis is mostly concerned with the examination of market and bargaining power along the rubber and palm oil supply chains in Jambi. Previous results show that market power is indeed an issue in Jambi, both at the village- and the processing level. Preliminary new results show that prices at rubber factory levels violate the economic law

Photo 22: Rakhma Sujarwo (center left) and her enumerator team in Jambi.

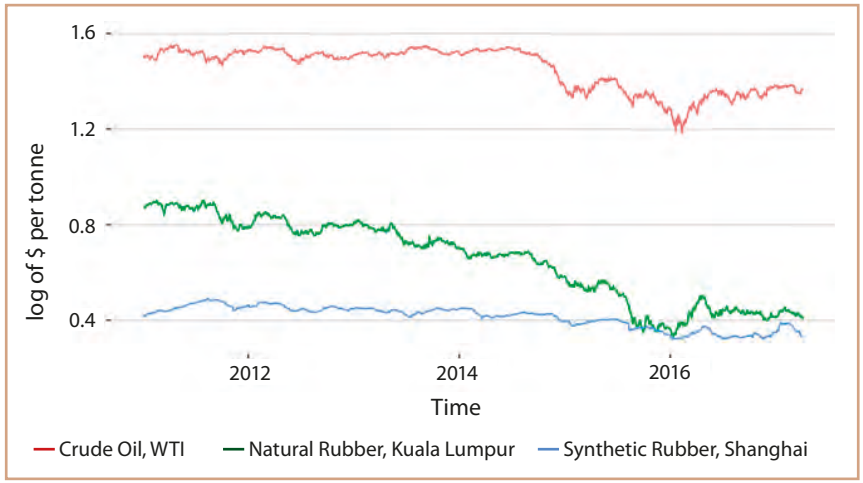


Figure 21: Intl' daily crude oil, natural and synthetic rubber prices, 2011-2017
(Source: Datastream and Shanghai shengiyshe Data Consulting Ltd.)

of one price. A theoretical model explains these deviations by the cost of migrating supply across factories faced by farmers. This has resulted in the presence and exertion of market power, part of which appears to be due to the ownership structure of factories. These dynamics have been revealed both theoretically and empirically using time series techniques.

A further aspect with great relevance for rubber price determination in Jambi is the structure of the international rubber market. The exact mechanisms which drives natural rubber prices, in particular the interlinkages with synthetic rubber and crude oil prices, is not well known in the existing literature. In a multivariate price transmission analysis, we will identify the core price linkages, with a special view towards the policy interventions of the Tripartite Rubber Council (ITRC), which is composed of Indonesia, Malaysia and Thailand. We analyse these interventions in terms of their effectiveness to influence prices along the supply chain – from the forests to the tires.

With regards to the palm oil market and similar to the rubber case, international price transmission is examined where crude oil prices are assumed to be in sync with palm oil prices. Yet, the major exporting countries, among those Indonesia, have come out with various attempts to control palm oil prices, which are subject to analysis.

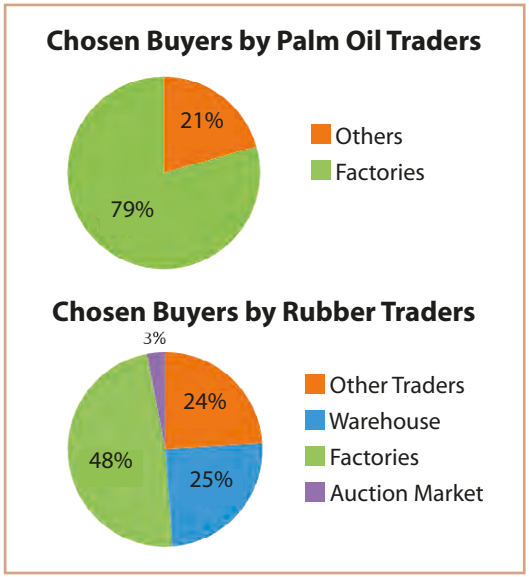


Figure 22: Buyers of palm oil and rubber traders
(Source: C01 2015 village trader survey).

C02

TITLE: **Socio-cultural and institutional transformation processes in rural Jambi**

TEAM: Principal Investigators: Heiko Faust (UGoe); Endriatmo Soetarto, Soeryo Adiwibowo (IPB); Rosyani (UNJA).
Scientific Staff: Jennifer Merten, Fenna Otten (Doctoral Researchers).
Associated Scientist: Jonas Hein

RESEARCH SUMMARY:

The German-Indonesian research team of C02 focuses on two main objectives of cultural landscape development.

The first work package investigates the spatio-temporal heterogeneities of local agricultural transformations by focusing socio-cultural and economic entanglements, and rural-urban linkages. So far, research was conducted in seven villages and indicates a variegated assemblage of influences, whereby geographical proximity to (regional) *urban centers* can only explain for some transformation processes, e. g. vegetable production for a growing urban food market or isolated small-scale land purchases. Other transformations that are due to developments in surrounding but *rural areas* include, for instance, the agricultural evolution of local villages under the influence of transmigration settlements. Beyond, many developments are taking place regardless of spatial proximity, but are based on trans-local linkages of kin and culture. This is exemplified in a transmigration village (rubber) where many villagers hold family relations to Medan and thus facilitated early oil palm cultivation.

Fundamentally, all transformation processes can be traced back to socio-cultural relations and attachment; they present a necessary precondition for change. Since villagers' social networks within and between research villages vary widely, the agricultural landscape mirrors a heterogeneous landscape mosaic (Figure 23).

The second work package focuses on farmer's perception of the impacts of land use change on local water resources, related consequences for their livelihoods as well as feedbacks for local resource governance. Six months of field work in 2016 and 2017 have revealed that recent societal and ecological transformation have led to increasing problems flooding in rainy season as well as water scarcity in dry season. Both reduce the ability of farmers to use their land efficiently and limit their number of crop choices. As land in Jambi is increasingly turning into a scarce resource, swamp and peat areas often represent the last frontiers of agricultural development. The management of these marginal lands, however, requires substantial technical knowledge and

Photo 23: Group discussion with farmers. From left to right: Kathrin Martens (M. Sc. student), Agustina Siregar (assistant), Oryza Gustining Setyowati (assistant), Jennifer Merten (doctoral researcher), farmers.

Photo 24: Young farmer harvesting his inundated oil palm plantation.

financial inputs. Consequently, a land accumulation by wealthy investors has been observed on these sites. Increasing swamp drainage and the redirection of water flows partly further increase problems of flooding on villagers' plantations. At a regional level the uncertainty of water flows additionally poses a great obstacle to government's efforts to increase food crop production (Photo 24).

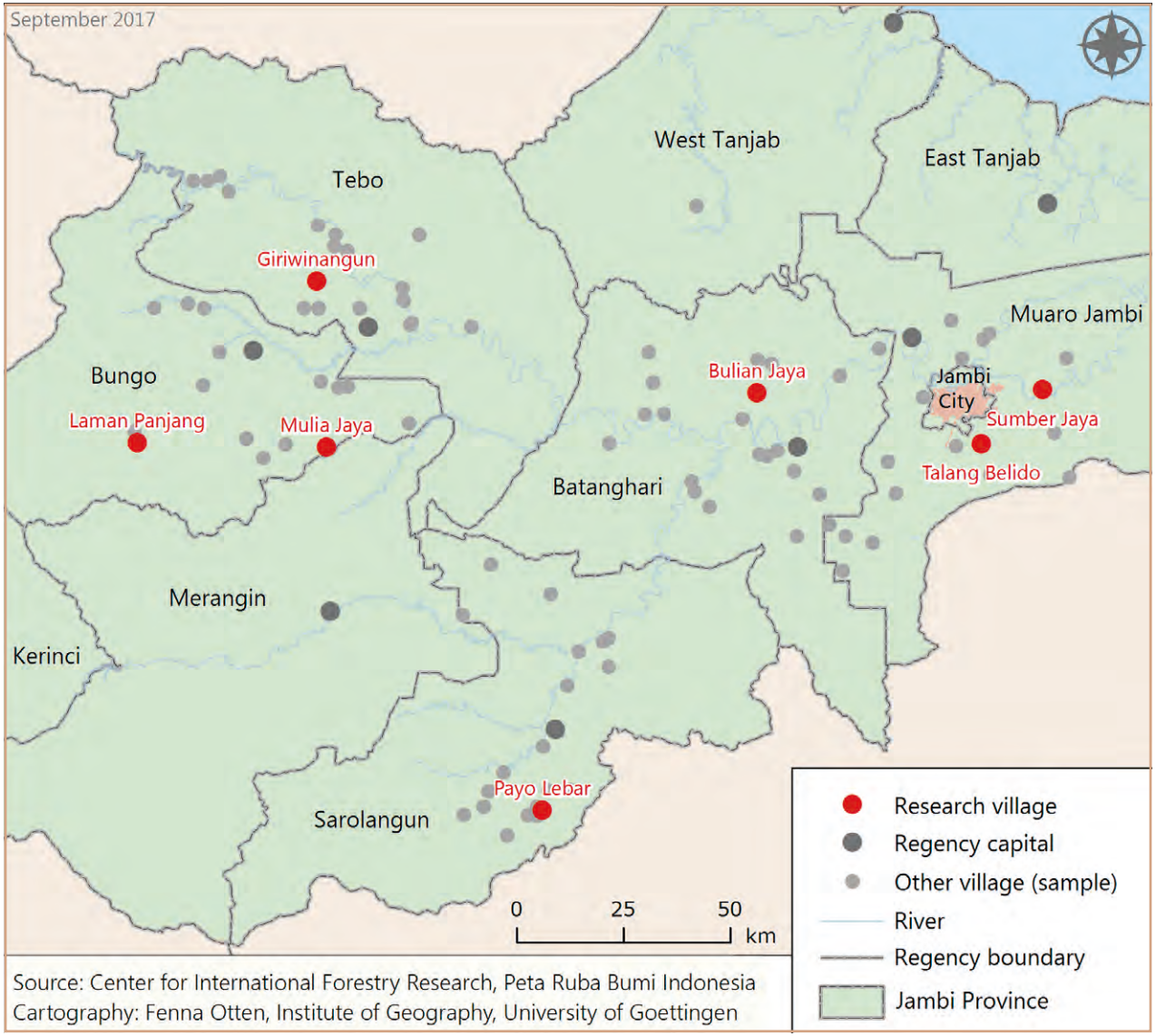


Figure 23: Research villages of C02.

C04

TITLE: **Mitigating trade-offs between economic and ecological functions and services through certification**

TEAM: Principal Investigators: Jann Lay (GIGA, Hamburg); Stephan Klasen (UGoe); Nunung Nuryartono (IPB); Dompak Napitupulu (UNJA).
Scientific Staff: Sebastian Renner (Postdoctoral Researcher).

RESEARCH SUMMARY:

The C04 team is currently conducting a survey of oil palm smallholder farmers, running from September to a scheduled end in November 2017. Interviews are taking place in the regencies of Batang Hari, Merangin, Muaro Jambi and Tanjung Jabung Barat. The long term objective of the proposed investigation is to evaluate the possible contribution of sustainable palm oil certification schemes for mitigating the trade-offs between production and income, on the one hand, and, ecological functions on the other. With our survey data, we try to establish causal links between participation in certification programs, with a focus on the Roundtable on Sustainable Palm Oil (RSPO) standards, and several outcomes on the household/farm level over time. The interviews are structured to obtain data on farm management practices such as fertilizer and herbicide use, potential price premiums for certified oil palm, yields and related household income. We systematically compare RSPO certified smallholder farmers with non-certified smallholder farmers organised in cooperatives. The survey is scheduled as longitudinal and to be repeated with the same farmers in 2018 and 2019.

Photo 25: Sebastian Renner (center) and survey team in the field.

C06

TITLE: **Encouraging the acceptance of RSPO and ISPO certification in Indonesia – a policy analysis**

TEAM: Principal Investigators: Oliver Mußhoff (UGoe); Dompak Napitupulu (UNJA).
Scientific Staff: Arieska Wening Sarwosri (Doctoral Researcher).

RESEARCH SUMMARY:

The scientific Project C06 focuses on the discussion of Roundtable Sustainable Palm Oil (RSPO) and Indonesian Sustainable Palm Oil (ISPO) certification of the smallholder farmer regarding their acceptance of the certifications. The field work lasted from October 2016 to January 2017, involving five local enumerators from UNJA and 800 smallholder farmers who lived in the area of rainforest transformation. The data collected through experimental method and the work was divided into three working packages (WP). The utilization of forests for oil palm production caused a social dilemma. The smallholder farmers obtain the ownership of the forest through *de facto* and they believe that their claim was legitimate based on the community law. Social conflict also arose while the oil palm expansion by deforestation improved their social-economics condition, yet on the other hand caused environmental damages.

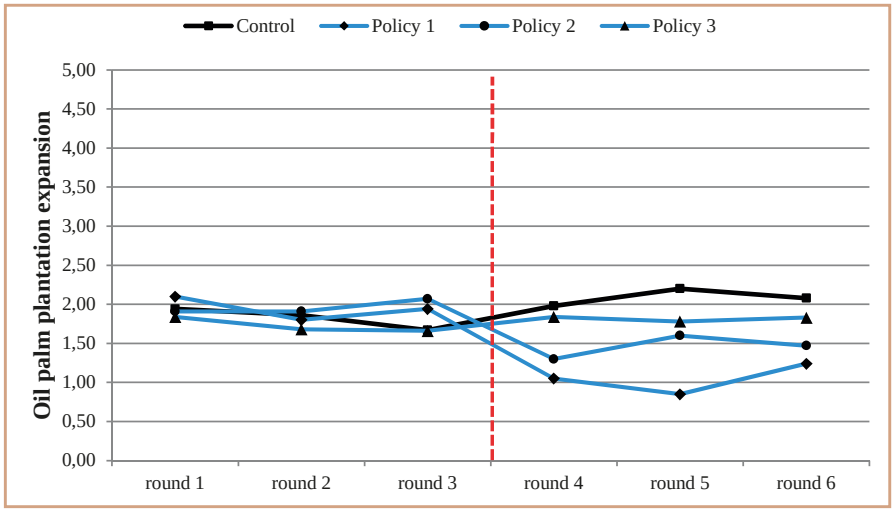


Figure 24: Oil palm expansion overtime (round 1 to 3 are the period before policy-interventions, round 4-6 are the period after policy-interventions.

Under these circumstances, the implementation of palm oil certification was less likely to gain success. Thus, in WP 1, we carried out an experiment of social dilemma, where the farmers decide to do oil palm expansion by deforestation with its consequences. We tested several policy intervention scenarios to reveal which policy is effective to deter deforestation by smallholder farmers. The responce of the farmers regarding oil palm expansion on WP1 is presented in Figure 24. The experiment involved six simulation years of decision for oil palm expansion. Those six simulations years were divided into two sequences: rounds 1-3 show the condition before the implementation of policy intervention scenario, while rounds 4-6 show the period when the policy was implemented. The dashed vertical lines represent the moment where the policy intervention scenario were given. Kruskal-Wallis-rank-sum-test was applied for round 1-3, p-value = 0.46 indicated the number of oil palm expansions were not-statistically-different for control and all policy-intervention scenarios. However, after the implementation of policies, the condition changed. We found that environmental information that fits with the local concern and the implementations of price premium for certified-palm oil were successful to deter the deforestation. The 'environmental information' that we delivered was in the form of map which depicted land used of Jambi Province from the year 1990 and the year 2011, we acquired these maps from B05.

In the WP 2 we measured the risk attitude and discount rate of the smallholder farmers. We adopted the Holt and Laury method to elicit the risk attitude and Coller and William method to elicit the discount rate. Finally, in the WP3 we investigated whether the risk attitude of Indonesian smallholder farmers changing overtime. To do so, we combined the dataset from C06 Phase 1 in the year 2012 with the dataset from Phase 2 which was collected during the years 2016-2017.

Photo 26: Social dilemma experiment in Pematang Kolim Village.

Photo 27: Farmer and his house in Lubuk Beringin Village. In the foreground: village kids and Arieska.

C07

TITLE: **Determinants of land-use change and welfare impacts among rural farm and non-farm households**

TEAM: Principal Investigators: Matin Qaim (UGoe); Hermanto Siregar (IPB), Zulkifli Alamsyah, Ummi Kalsum (UNJA).
Scientific Staff: Christoph Kubitza (Doctoral Researcher), Kibrom T. Sibhatu (Postdoctoral Researcher).
Associated Scientists: Jonida Bou Dib, Daniel N. Chrisendo (Doctoral Researchers).

RESEARCH SUMMARY:

During the last few months, the C07 team could welcome two new team members. The first new member is Dr. Kibrom Tadesse Sibhatu, who joined the team in August 2017 as a postdoctoral researcher, taking over the position that Dr. Vijesh Krishna had held before (Vijesh took on a leadership position at an international agricultural research center, but remains an associated CRC research fellow). The second new member is Mr. Daniel Naek Chrisendo, who joined in April 2017 as a doctoral researcher with an LPDP Scholarship from the Indonesian Government.

In terms of research contents, we used the farm household data collected in 2012 and 2015 to analyze the socioeconomic effects of oil palm cultivation among smallholders with panel data models. This analysis builds on our earlier work with cross-section data. Results show that growing oil palm has positive effects on farmers' livelihoods. In particular, the economic gains from oil palm cultivation contribute to higher household consumption, measured in terms of expenditures on food and non-food goods and services (Figure 25). Oil palm is less labor-intensive than rubber, the main alternative cash crop. Lower labor requirements allow oil palm farmers to further expand their farmland or reallocate the saved labor time to non-farm economic activities, thus contributing to additional secondary gains. Due to declining rubber prices, the economic incentives for farmers to adopt oil palm further increased between 2012 and 2015. Policies aimed at regulating further oil palm area expansion will have to account for the economic benefits of this crop for the local population.

In a joint study with the B05 team, we have analyzed institutional factors that could contribute to reducing deforestation and land-use change. Combining the household survey data with satellite imageries we tested the hypothesis that stronger land property rights lead farmers to increase their input intensity and productivity on the already cultivated land, thus reducing incentives to expand their farms by deforesting additional land. The data largely confirm this hypothesis. Results show that plots for which farmers hold formal land titles are cultivated more intensively than untitled plots. Land titles also contribute to high-

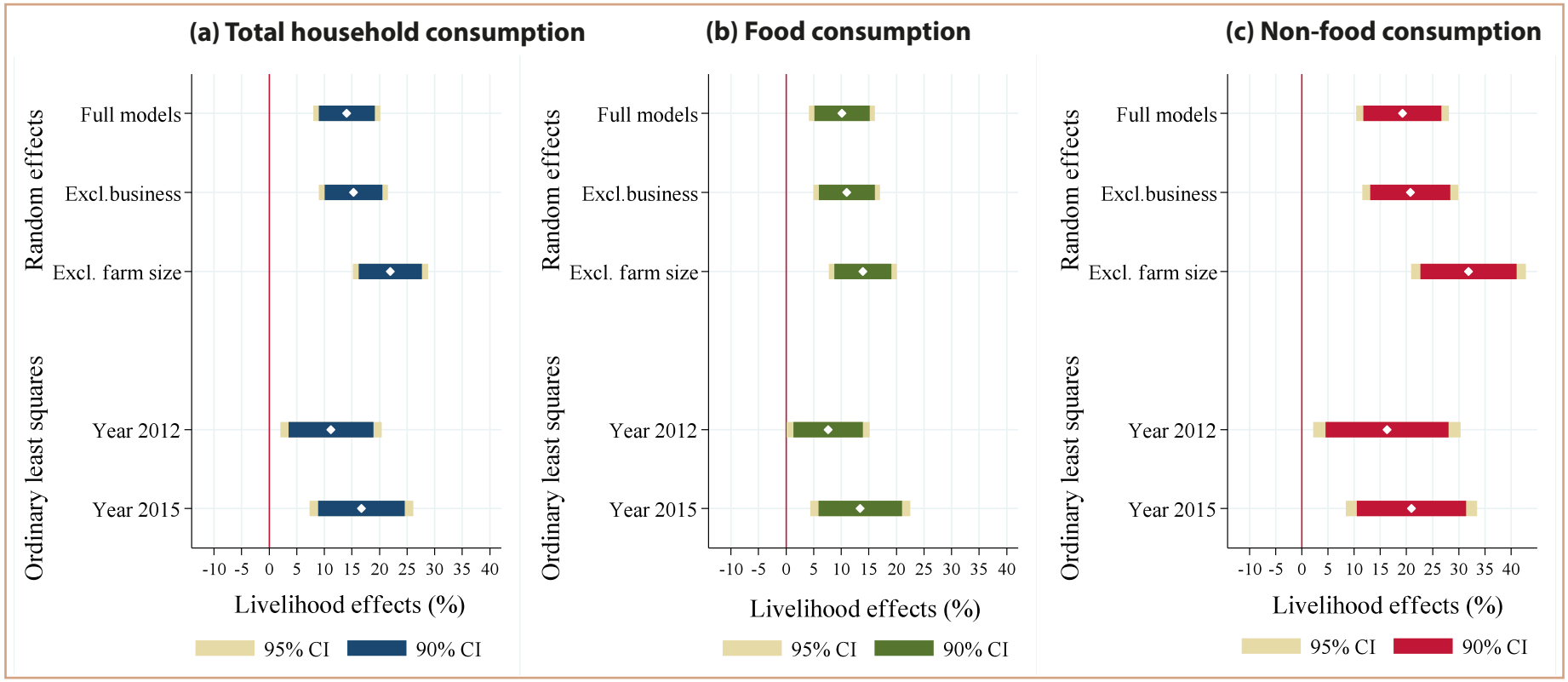


Figure 25.: Livelihood effects of oil palm adoption among farmers in Jambi. Net effects on different livelihood indicators (total household consumption, food consumption, non-food consumption) are shown in percentage terms with different model specifications. CI, confidence interval.

er crop yields. However, due to land policy restrictions, farmers located at the historic forest margins often do not hold formal titles for the land they cultivate. Without land titles, these farmers are less able to intensify and more likely to expand into the surrounding forest land to increase agricultural output. Indeed, forest closeness and past deforestation activities by households are found to be positively associated with current farm size. The findings suggest that the observed land policy restrictions are not conducive for forest conservation.

C08

TITLE: **Designing effective policy instruments to induce sustainable land use**

TEAM: Principal Investigators: Meike Wollni (UGoe), Bambang Juanda (IPB), Edison (UNJA).
Scientific Staff: Miriam Romero (Doctoral Researcher).
Associated Scientists: Jana Juhrbandt (Postdoctoral Researcher, Katrin Rudolf (Doctoral Researcher)

RESEARCH SUMMARY:

- A comprehensive end-line survey was completed in 36 villages from October to December 2016 covering a total of 766 oil palm farmers. In addition to socio-demographic characteristics, oil palm management, tree planting activities, environmental and subjective beliefs, we captured actual adoption of tree planting.
- In collaboration with A04, 150 plantations (on 3 soil types) were selected from the overall sample to collect soil samples.
- Miriam Romero and Vijesh Krishna (C07) are working on a collaborative paper investigating the spatial effects in oil palm intensification across transmigrant and autochtonous villages. Their analysis is based on plot, household and village level data from 77 villages and three years (2012, 2015, 2016) collected by C07 and C08.

Photo 28: Field visit of Miriam Romero (fifth from left).

Photo 29: Field visit of Katrin Rudolf (sixth from left).

- Katrin Rudolf and Nina Hennings (A04) are working on a collaborative paper related to: *SOC losses as an agronomic impact factor on oil palm yields: A comparison of three different treatment practices on oil palm plantations and their effect on soil fertility and oil palm yields*.

SELECTED RESULTS:

Promoting trees at the oil palm frontier: Experimental evidence from Indonesia
(Miriam Romero, Katrin Rudolf, Meike Wollni)

Using a randomized controlled trial we investigate the effectiveness of information and structural interventions in promoting native tree planting in smallholder oil palm plantations. We implemented two treatments: (1) an information campaign and (2) an additional provision of saplings to overcome missing markets for seed material. Using data from baseline, post-experimental and end-line surveys, we analyzed farmers' perceptions of native tree planting in oil palm, intentions to plant and actual tree planting decisions. Our results show that farmers' perceptions of eco-

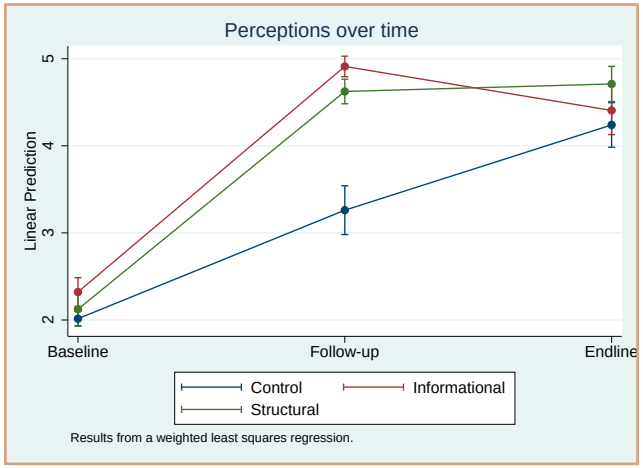


Figure 26: Farmers' perceptions of ecosystem services provided by native trees in oil palm plantations.

system services provided by trees in oil palm improve in the short term as a result of the interventions. However, perceptions decrease in the longer term, if only information is provided, and thus, only the structural intervention has a significant and positive long-term effect on perceptions (see Figure 26). Furthermore, regression results show that both interventions have a positive and significant effect on the intention to plant native trees in oil palm. Yet, when looking at actual planting behavior, only the structural intervention has a positive and significant effect.

Scientific projects Z02 and INF

Z02 FIELDS OF RESEARCH

- Monitoring of meteorological variables
- Barcoding the vasuclar plants and their roots of the study sites
- Monitoring of aboveground animal biodiversity
- Function as central unit on the Convention of Biological Diversity (CBD)

INF FIELDS OF RESEARCH AND DATA MANAGEMENT

- Information system (EFForTS-IS)
- Embedded research data management
- Integrative statistical analysis
- Small services and general support
- Data sharing and monitoring
- Training and workshops
- Network and dissemination

Z02 – Central Scientific Service Project

TITLE: **Monitoring meteorological variables (WP1)**

TEAM: Principal Investigators: Alexander Knohl (UGoe); Dodo Gunawan (BMKG).
Scientific Staff: Christian Stiegler, (Postdoctoral Researcher).
Techinical Staff: Malte Puhan, Edgar Tunsch.

RESEARCH SUMMARY:

Comparison of microclimate in various land-use systems in Jambi, Indonesia

Microclimatic conditions on a daily, weekly and seasonal basis across four land-use systems were characterized and the effect of the strong ENSO event in 2015 on the microclimate was investigated. The analysis is based on microclimatic measurements e.g. air temperature, relative humidity, soil moisture and soil temperature taken in four land-use systems, forest, jungle rubber, oil palm and rubber, in two different landscapes, Harapan and Bukit. The data set covers a period of approximately three years from April 2013 to March 2016.

The results showed that mean air temperature, soil temperature, relative humidity and vapour pressure deficit differed significantly between four land-use systems whereas the mean soil moisture differed significantly between two landscapes

(Figure 27). Air temperature, vapour pressure deficit and soil temperature were highest in oil palm and rubber plantations whereas lowest in forest and jungle rubber. After the ENSO of 2015, a significant increase in mean air temperature, soil temperature and vapour pressure deficit but a decrease in relative air humidity and soil moisture in all four land-use systems was found (Figure 28). However, among the increase of air temperature and the decrease of air humidity, the effect of ENSO was highest in forest and jungle rubber compared to rubber and oil palm plantations. Furthermore, air temperature, soil temperature and vapour pressure deficit were positively correlated with canopy openness whereas relative humidity was negatively related with canopy openness.

In conclusion, conversion of forest to rubber and oil palm plantations has led to warmer and drier microclimatic conditions than before. In addition to this, the effect of the ENSO event of 2015 was noticed in all four land-use systems with warmer and drier conditions than in 2013 and 2014.

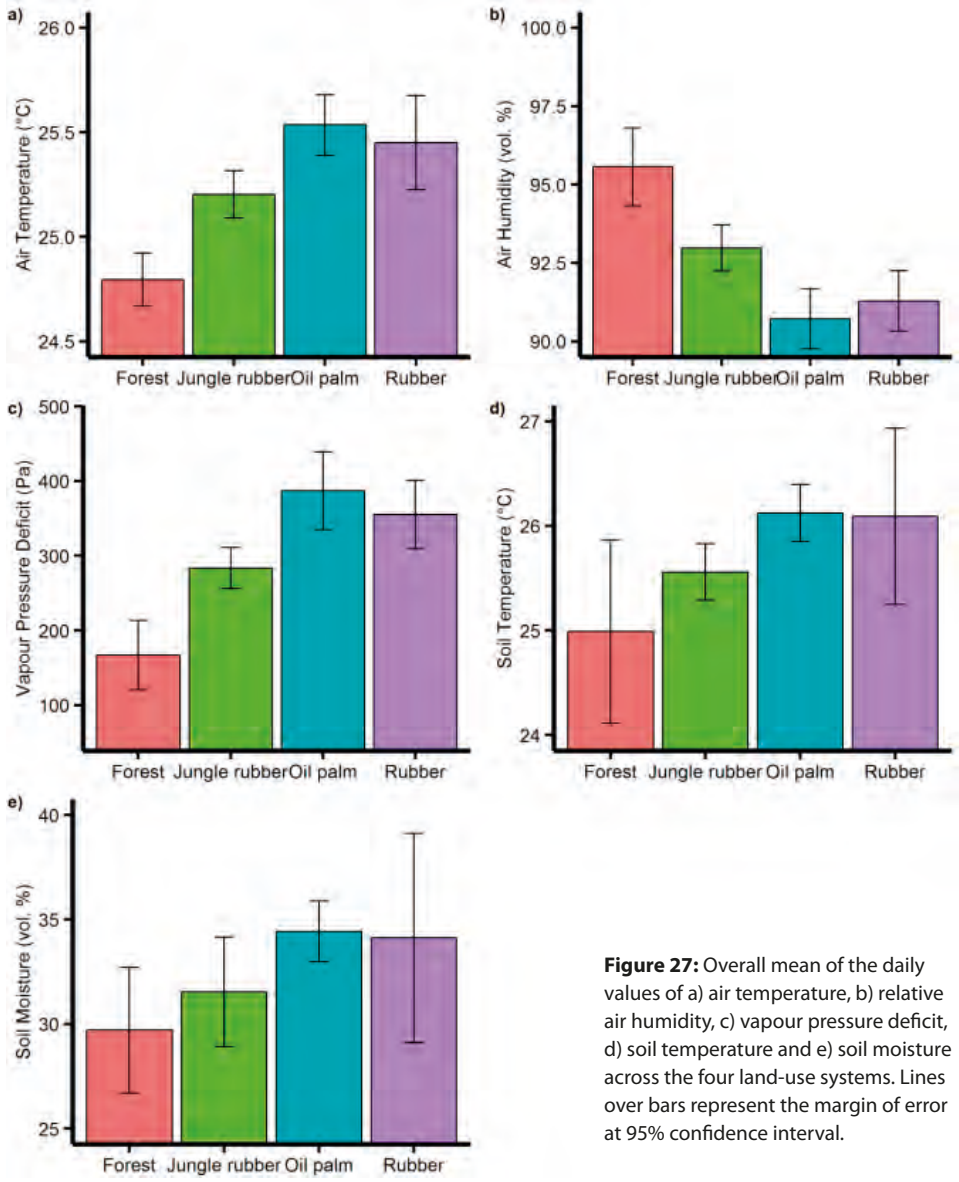


Figure 27: Overall mean of the daily values of a) air temperature, b) relative air humidity, c) vapour pressure deficit, d) soil temperature and e) soil moisture across the four land-use systems. Lines over bars represent the margin of error at 95% confidence interval.

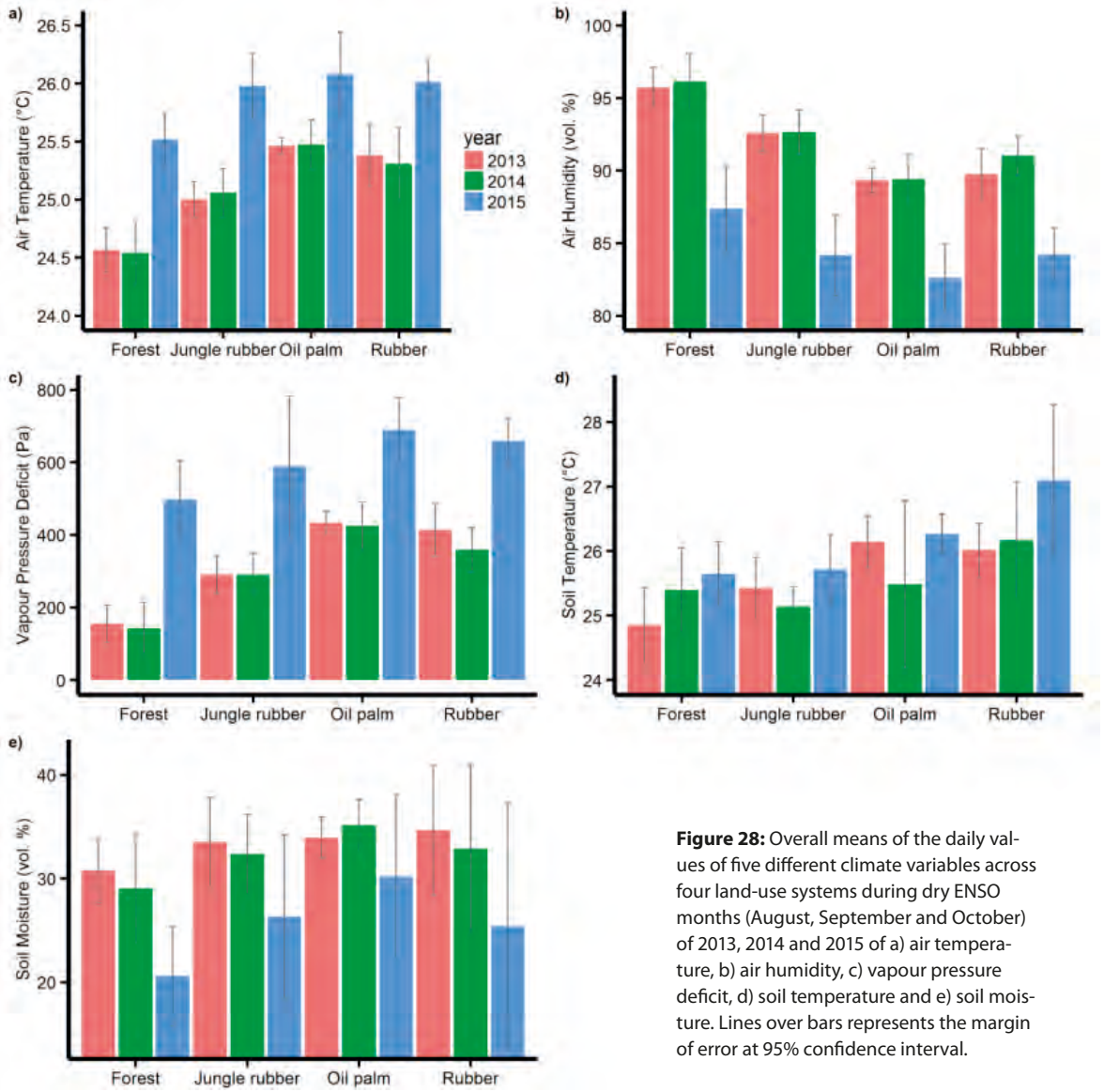


Figure 28: Overall means of the daily values of five different climate variables across four land-use systems during dry ENSO months (August, September and October) of 2013, 2014 and 2015 of a) air temperature, b) air humidity, c) vapour pressure deficit, d) soil temperature and e) soil moisture. Lines over bars represents the margin of error at 95% confidence interval.

Z02 – Central Scientific Service Project

TITLE: **Monitoring aboveground biodiversity: Canopy Arthropods (WP3)**

TEAM: Principle Investigators: Stefan Scheu (UGoe); Damayanti Buchori, Purnama Hidayat (IPB).
Scientific Staff: Jochen Drescher (Postdoctoral Researcher)

RESEARCH SUMMARY:

The scientific project Z02 (Central Scientific Service Project) aims at monitoring canopy arthropod assemblages in the EFForTS core plots. The ultimate goal is to establish a collection in which all specimens are identified to species level, including phylogenetic analysis (DNA barcoding) and photographic documentation. Given that there will be many species unknown to science in the samples, Z02 is also responsible to organize the description of new species by taxonomists around the world. In two fogging campaigns in the dry season 2013 and the rainy season 2013/14, we collected an estimated 800.000 specimens belonging to 31 arthropod orders. A third fogging campaign just has been completed in September 2017 by a mixed team of Z01 assistants and Z02 researchers form UGoe and IPB (Photo 30). Currently, we are focusing on the analyses of four major groups, i.e. the ants (Figure 29), parasitic wasps, springtails and beetles.

Photo 30: Z02 field team in the Harapan Rainforest. From left to right: Yohanes Toni Rohaditomo (B.Sc., field team), Dr. Purnama Hidayat (counterpart), Rizky Nazzareta (doctoral researcher), Dr. Jochen Drescher, Amanda Mawan (doctoral researcher), Yohanes Bayu Suharto (M.Sc., field team), Mohamad Syaifullah Hiola (B.Sc., field team).

Ants (Formicidae): With the help of assistants and MSc students we have sorted more than 140.000 ant specimens from the dry season 2013 and the rainy season 2013/14 to ca. 250 morphospecies. We are in contact with taxonomists for checking the identification and describe some of the likely >50 ant species currently unknown to science. To document the specimens and place them in a database, which is currently under construction, we take high-resolution photographs from all sides including the faces (Figure 29). In parallel, we work on the phylogeny of the ants from Jambi using ribosomal DNA and mitochondrial DNA markers.

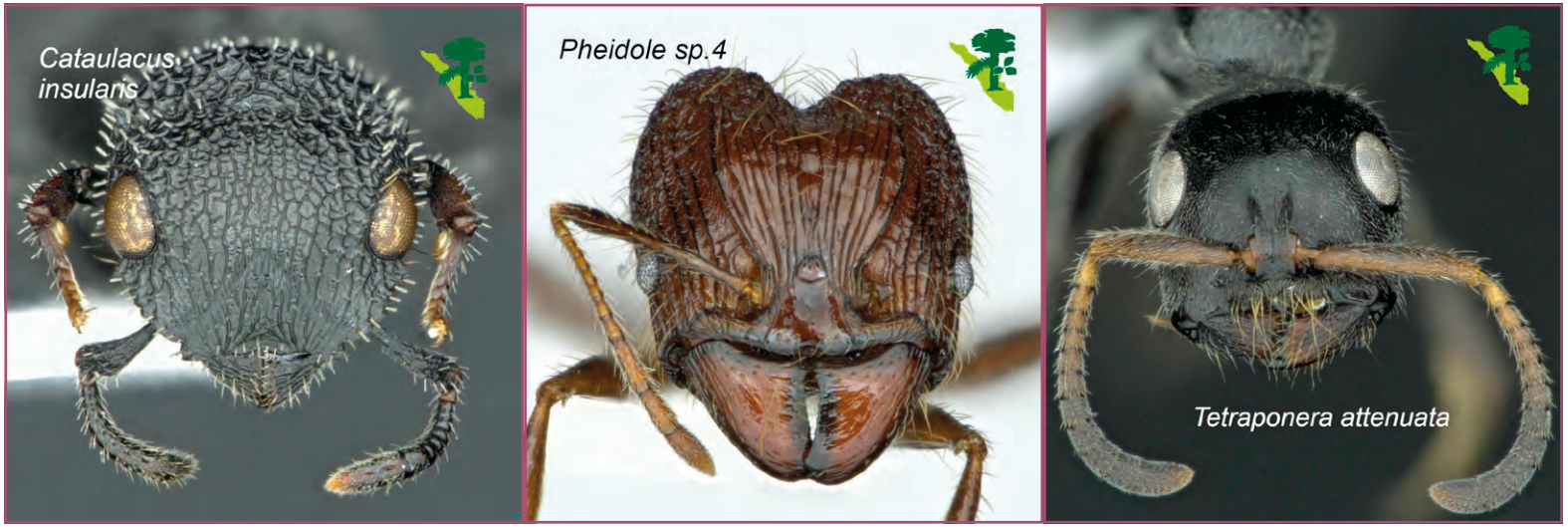


Figure 29: Examples of photographic ant documentation. Frontal pictures of (a) *Cataulacus insularis*, (b) an unidentified *Pheidole* species, and (c) *Tetraponera attenuata*.

Parasitic wasps: In addition to ants we sorted >25.000 individuals to >30 families of Hymenoptera, including the true wasps and bees. We focused on five major families of parasitic wasps, i.e. Braconidae, Ceraphronidae, Encyrtidae, Scelionidae and Platygastridae. After classification of >10.000 specimens to >1000 morphospecies at IPB, we commenced molecular analyses in the framework of a master theses at UGoe. After initial problems with degraded DNA have been tackled, the construction of a phylogeny of parasitic wasps from Jambi is under way, and new samples will allow us to test the validity of rapid molecular biodiversity assessment using New Generation Sequencing (NGS) methods.

Springtails (Collembola): From the dry season sampling 2013 and the rainy season sampling 2013/14 we have identified >200 morphospecies from nine families (Brachystomellidae, Cyphoderidae, Entomobryidae, Hypogasturidae, Isotomidae, Odontellidae, Oncopoduridae, Paronellidae, Sminthuridae). We currently check intraspecific and interspecific variance of ribosomal and mitochondrial DNA in Entomobryidae and Paronellidae. A PhD student from Indonesia is expected to join our team in Göttingen soon.

Beetles (Coleoptera): Beetle species identification of the 2013/14 samples is under way at IPB, currently focusing on three families, Curculionidae, Elateridae, and Staphylinidae. First results confirm the patterns from other groups such as ants, i.e. species richness and diversity is higher in rainforest and jungle rubber than in rubber and oil palm, and community compositition is significantly different.

INF Research Data Management and Integrative Statistical Analysis

TEAM: Principle Investigators: Wolfram Horstmann, Thomas Kneib, Ramin Yahyapour (UGoe); Suria Darma Tarigan (IPB), Junaidi Sutan (UNTAD).
Scientific Staff: Thomas Fischer, Timo Gnadt, Paul Magdon, Peter Pütz, Bernd Schlör.

RESEARCH SUMMARY:

INF has been working on setting up a new instance of the data platform, EFForTS-IS, on the basis of the new and revised software BExIS2, and migrating data from the current system. In this matter, INF largely depends on the progress of the project BExIS++ in Jena, which develops the new version. While many functionalities that are required for the CRCs use of this platform have already been implemented, some core features were supposed to be available in a new release from August 2017. This release, however, had to be delayed by the BExIS developers to late October because of performance issues. While INF is already working on processes to move the old data to the new platform, and will be supported in this migration process by the BExIS++ developers, INF will also have to postpone the originally targeted migration timeframe from late fall 2017 to early 2018.

Regarding the STORMA and ELUC datasets which are stored in EFForTS-IS, INF is evaluating suitable archives for moving the data out of EFForTS-IS and make them available publicly. The procedure is being discussed with the CRCs Coordination and the Data Management Board. In the past year, INF has redesigned the EFForTS Sharepoint to improve the file handling and usability of the platform. The new Sharepoint was launched in June 2017. INF has also been in discussion with several SPs to support them with restructuring of their internal databases.

In supporting researchers on matters of statistical analysis, INF provided consultancy for the analysis of research data. From one of these consultancies, a publication co-authored by one INF member emerged (Darras et al., 2016). Future research collaborations are desired. In August 2016, a well-attended course on mixed models was taught. Further courses are planned and the next one will be given in October 2017, this time on the very relevant topic of applied statistical inference. Since August 2017, INF is supported by the student assistant Henning Kosmalla.

Regarding personnel matters, Thomas Fischer is leaving INF at the end of October 2017 for his retirement. Until his position is filled again, Daniel Kurzawe and Timo Gnadt will ensure that the ongoing tasks of managing the EFForTS-IS, consulting SPs on data management issues and supporting the CRC in IT and technology matters, are maintained.

Photo 31: INF team members at oil palm plantation (from left to right: Peter Pütz, Timo Gnadt, Daniel Kurzawe, Junaidi Sutan)

II. Integration of Ecological and Socioeconomic Research

Integration / integrative research activities across disciplines is realized through

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

1. The enrichment experiment

B11

TITLE: **Biodiversity enrichment in oil palm plantations: plant succession and integration (EFForTS-BEE)**

TEAM: Principal Investigators: Dirk Hölscher, Holger Kreft, Meike Wollni (UGoe); Leti Sundawati, Damayanti Buchori, Yeni Mulyani (IPB); Bambang Irawan, Rince Muryunika (UNJA).
Scientific Staff: Clara Zemp (Postdoctoral Researcher).

Photo 32: Group picture of the B11 team in 2016. From left to right: Bambang Irawan (counterpart), Clara Zemp (Postdoctoral Researcher), Pak Haspi (plantation manager at PT. Humuscrido), Dirk Hölscher (PI), Holger Kreft (PI), Leti Sundawati (counterpart) and Juliandi (field assistant).

RESEARCH SUMMARY:

The transformation of rainforests into oil palm plantations leads to dramatic losses in biodiversity and in ecological functioning. In order to test possibilities for alleviation, we established a biodiversity enrichment experiment (EFForTS-BEE) by planting tree islands in an oil palm landscape in December 2013. The plantings comprise four island sizes and six native multi-purpose tree species at different species diversity levels with a total of 56 experimental plots.

The first phase of the experiment already explored the link between biodiversity, tree growth, ecosystem structure and functions. During the second phase, we continue monitoring tree growth and deepen the analysis by creating 3D models of the vegetation using a terrestrial laser scanner (ground view) and an unmanned aerial vehicle UAV (aerial view). Our preliminary results indicate that planting trees species significantly enhances stand structural complexity in oil palm plantations (see Figure). EFForTS-BEE is one of the joint research platforms of the CRC 990, and several scientific projects have already started research on prokaryotes (B02), fungi (B07), below-ground (B13, B08) and above-ground (B09) invertebrates and birds (B09). In collaboration with scientific projects A02 and A03, we started monitoring

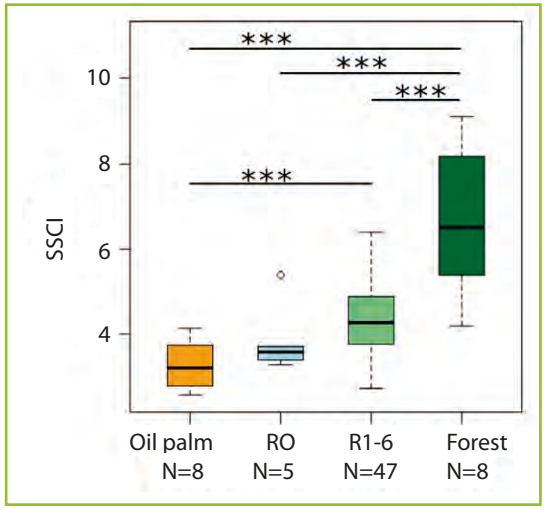


Figure 30: Stand Structural Complexity Index (SSCI) of oil palm monoculture, experimental enrichment plots with no living trees (species richness = 0, 'R0'), experimental enrichment plots with living trees (species richness between 1 and 6, 'R1-6') and rainforest. Statistical significant differences are shown (*** indicates p-value < 0.001). The number of plots for each land-use type (N) is also indicated. (Zemp et al. unpublished data).

micro-climate heterogeneity and temporal variability using 200 temperature and humidity data loggers, a climate tower and an UAV equipped with a thermal camera. Further ecosystem functions are analyzed, including leaf litter fall and decomposition (B08), pollination (B09, A01) and plant water-use (A02). To assess socio-economic and ecological trade-offs in greater details, we substantially enhanced the monitoring of oil palm yield. An information campaign was conducted in 24 villages followed by a distribution of the six tree species in order to shed light on farmers' perception of the benefit of tree planting in oil palm plantations (C08).

Seed dispersal is a main limiting factor for ecological restoration by tree plantings in degraded tropical landscapes. Long-distance seed dispersal events by bats and birds are expected to play an important role in the tropics. This is the topic of a join project in collaboration with scientific project B09. Our research questions are: (1) What is the role of bats and birds for long-distance seed dispersal in oil palm plantation enriched with tree plantings? (2) How are long-distance dispersal events controlled by the landscape matrix and the tree island characteristics? Observations using night-vision devices, trapping cameras and mist-nets in the landscape indicate that bats (especially *Cynopterus brachyotis)* feed on fruits from native tree species (mainly *Ficus variegata* and *Fagraea fragrans)* consistently throughout the seasons. Using an UAV flying over the landscape in 2016, we identified 43 isolated trees and 22 areas of interests including forest fragments and riparian sites, which are potential feeding and roosting sites for bats and birds. In each of these sites, photos and samples of the fruiting plants have been taken for building a reference collection and taxonomic identification (in collaboration with scientific project B06). We conducted a pilot study to develop our methodology, which combines seed tracking and trapping methods as well as bat and bird point counts from direct observations and sound recordings.

2. Four thematic foci

Focus 1

TITLE: **Assessment of ecological and socioeconomic functions, synergies and trade-offs across different land-use systems**

REPRESENTATIVES: Ingo Grass, Oliver Mußhoff

RESEARCH SUMMARY:

Identifying trade-offs and synergies among ecological and socioeconomic functions is a major aim of the interdisciplinary research within Focus 1. At current, we are working on an interdisciplinary manuscript that investigates biodiversity-profit relationships in smallholder farming systems. Using data from the core plots, first results indicate non-linear relationships between species richness and gross margins of farmers that are strongly linked to taxonomic identity (Figure 31). Furthermore, these relationships differ depending on whether all species or only those that also occur in forests are investigated. In addition, we developed an analytical approach that searches for land-use composition that maintains the highest possible levels of species richness while simultaneously exceeding *a priori* defined levels of economic profitability. For a range of profitability threshold levels, the analysis shows that even if land-use compo-

sition is optimized to allow for the highest levels of biodiversity at landscape scales, increasing profitability expectations beyond a certain threshold will always result in steep drops in biodiversity (Figure 32). The analysis may allow for identifying threshold levels of intensification, where both biodiversity and relatively high levels of economic profitability can be maintained at landscape scales. Further taxonomic groups as well as ecosystem functions remain to be integrated into both analyses.

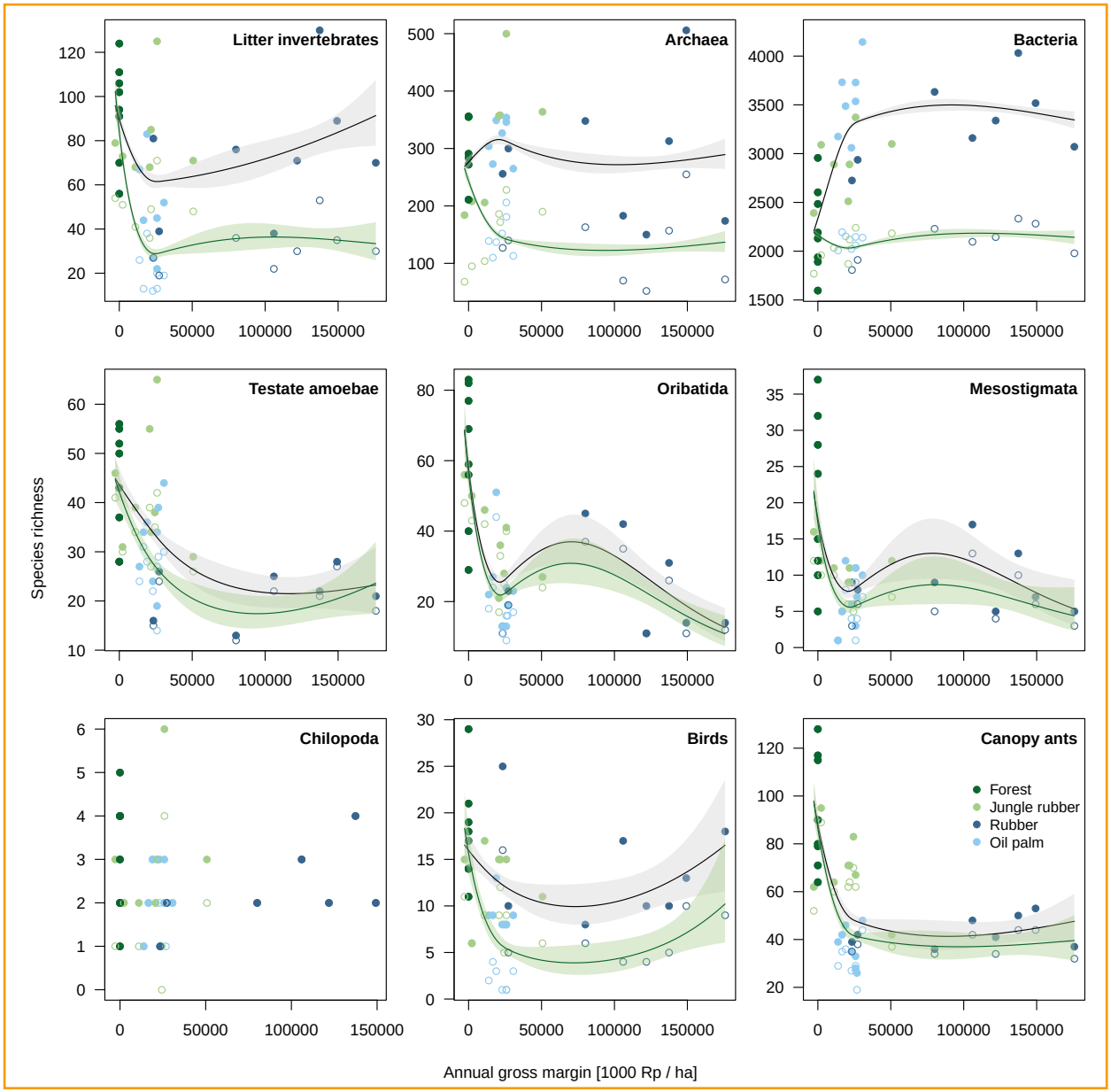


Figure 31: Biodiversity-profit trade-offs in Indonesian smallholder systems. Shown is the species richness of nine taxonomic groups in response to annual gross margin, using biodiversity and yield data from the core plots collected between the years 2013 and 2014. Non-linear relationships are modeled for species richness based on 1) all species (filled circles and grey predictions) and based 2) only on those species that also occur in forest (open circles and green predictions). Solid lines: mean model prediction. Shaded areas: 95% confidence intervals.

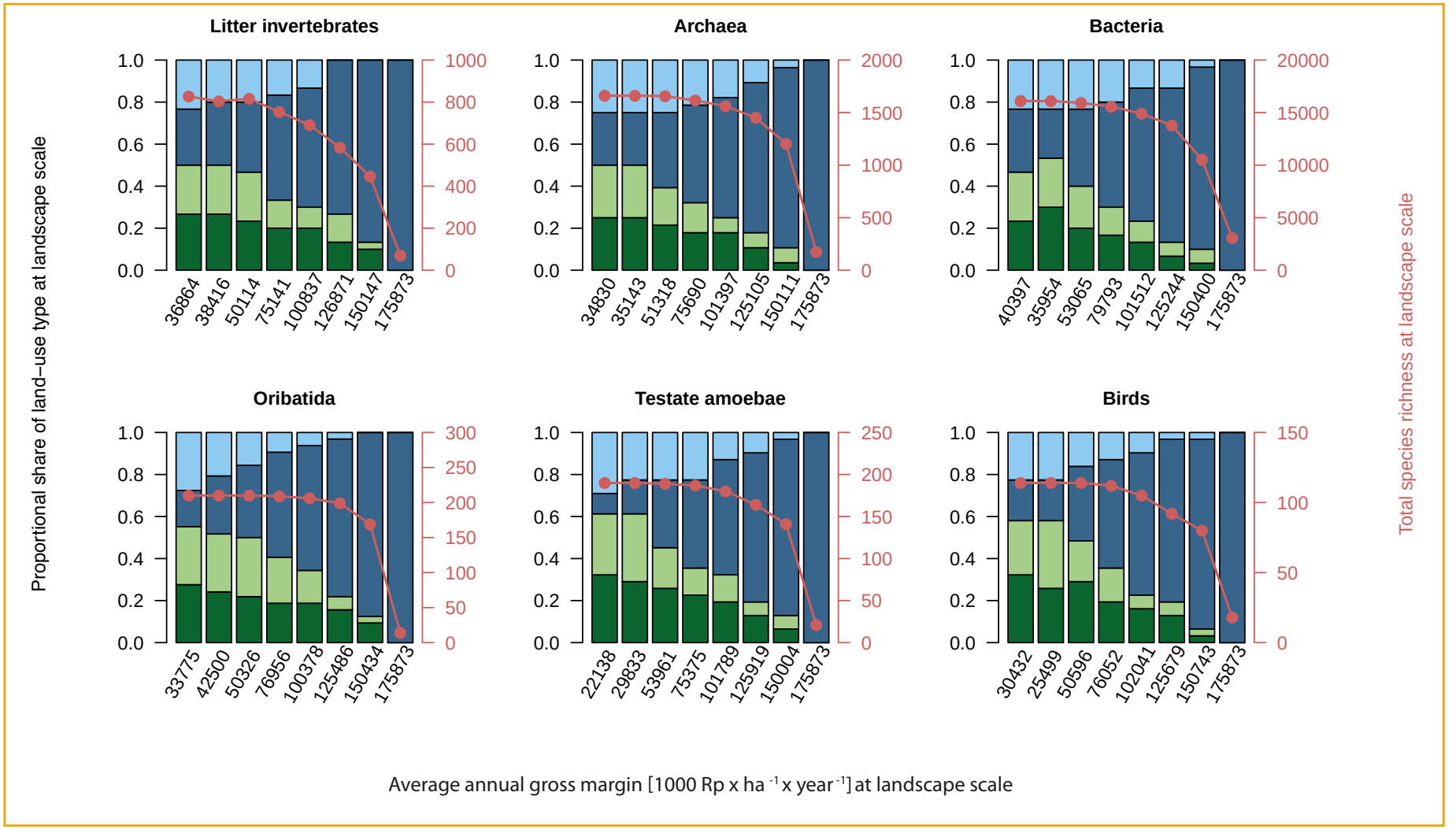


Figure 32: Optimized land-use composition for minimum levels of profitability (annual gross margin) at landscape scale. Shown are results from a genetic algorithm that searches for the optimal land-use composition that allows for an *a priori* defined minimum level of economic profitability while simultaneously maximizing species richness at landscape scale. For each taxonomic group, the analysis was conducted for eight levels of minimum profitability: 0, 25000, 50000, 75000, 100000, 125000, 150000 and 175000 (all values in 1000 Rp / ha^{-1}). The solution that resulted in the highest species richness at landscape scale may differ from these levels, but note that they always exceed the minimum profitability. Land-use types: dark green = forest, light green = jungle rubber, dark blue = rubber, light blue = oil palm.

Focus 2

TITLE: **Quantifying the effects of spatial, temporal and social heterogeneity on ecological and socioeconomic functions**

REPRESENTATIVES: Matin Qaim, Holger Kreft

RESEARCH SUMMARY:

Ongoing research of EFForTS demonstrates that land-use systems differ significantly in key ecological and socioeconomic functions. However, there is also a high degree of variability in the functions within each land-use system, suggesting an important role of spatial, temporal and social heterogeneity. For instance, differences in soil quality, plant and tree age, plot size, spatial configuration and historical land use as well as social factors, local institutions such as land property rights, and access to markets and infrastructure may additionally affect ecological and socioeconomic variables measured for each land-use system. Understanding the role of heterogeneity is key for understanding complex socio-ecological systems as a whole, for identifying win-win solutions of efficient, sustainable land-use management and for balancing human needs and ecosystem functions and services in human-dominated landscapes. Focus 2 contributes in this direction.

Various papers from the different projects have analyzed relationships between land property rights, agricultural input intensity, biodiversity, environmental efficiency, productivity, and farm income in rubber an oil palm. Understanding these relationships helps to explain ecological and socioeconomic heterogeneity. Research also showed that the economic benefits that farmers derive from rubber and oil palm cultivation crucially depend on household access to land, labor, and off-farm income opportunities (Krishna et al. 2017; Euler et al. 2017). Village-level welfare depends on historical events: villages in which farmers started oil palm cultivation early on under a company contract developed faster in terms of various welfare indicators than villages in which farmers had no contracts in the past (Gatto et al. 2017).

Analysis for a broader collaborative Focus 2 paper with several projects involved is currently being conducted. The idea of this paper is to explain observed heterogeneity in ecological and socioeconomic functions through heterogeneity in landscape composition and configuration. We hypothesize that ecosystem functions and services on a particular plot that is located in a mosaic landscape vary not only by the characteristics of the plot itself, but also by how the surrounding landscape is composed and configured. Combining measurements of biodiversity, yield, and various other parameters taken from the core plots (and possibly the household survey) with satellite imageries of the surrounding landscapes will allow us to estimate statistical models to identify causal relationships.

Focus 3

TITLE: **Quantifying the effects of spatial, temporal and social heterogeneity on ecological and socioeconomic functions**

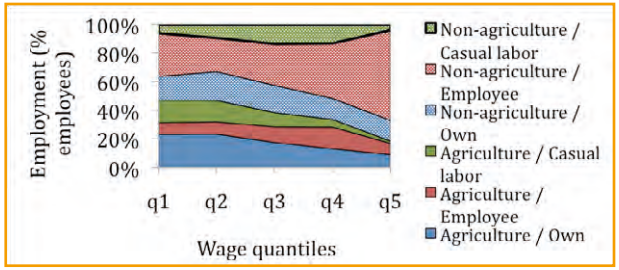
REPRESENTATIVES: Stephan Klasen, Thomas Kneib

RESEARCH SUMMARY:

Focus 3 is concerned with scale issues. It investigates how ecological and socioeconomic functions and their interactions change as one moves across different spatial scales and in particular from localized to higher / broader spatial scales. The research is guided by four main hypotheses:

1. Ecological and socioeconomic functions and their trade-offs change from local to higher scales;
2. Spatial configuration of the landscape mosaic matters differently at different scales;
3. Land-use transformations and intensification affect the scale dependency of functions and trade-offs (e.g species area relationships);
4. Decision-making at household level affects land-use changes at different scales.

At present, Focus 3 is working on two papers associated with these hypotheses.



1) Oil Palm expansion and income diversification at different spatial scales

Kubitza (C07) is leading an analysis to examine how oil palm expansion is affecting income diversification at different spatial scales, thus focusing on hypothesis 1. As shown below, off-farm employment is a major source of income in rural Indonesia, associated with higher earnings.

Oil palm expansion could lead to a substantial increase in off-farm employment as labor requirements are lower in oil palm, compared with rubber or other agricultural activities (particularly lower demand for female labor). At a higher spatial scale, however, an oversupply of off-farm labor decreasing labor demand in agriculture could depress wages and employment opportunities, thereby reducing the scope for off-farm employment as a pathway out of poverty. This could in particular affect landless labor households. These issues will be examined using both the C07 household survey, the C01 trader, the C08 farm and households surveys in Jambi as well as PODES village level data and Sakernas labor force data from the national statistics office. Regressions

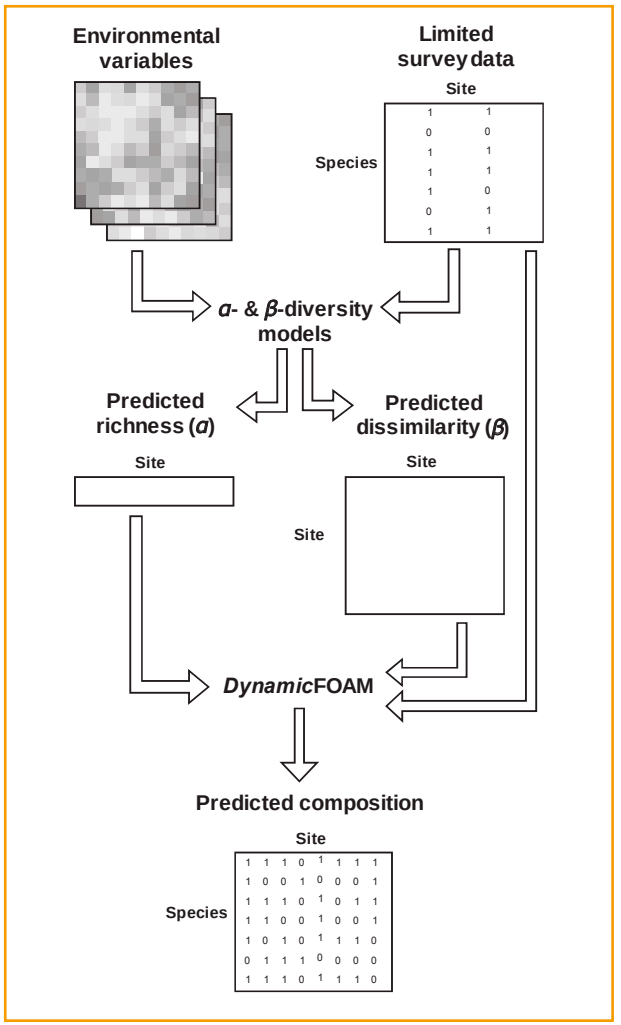


Figure 33: Workflow of the dynamicFOAM optimization algorithm (Mokany et al. 2011).

Mokany K, Harwood TD, Overton JM, Barker GM, Ferrier S. Combining alpha- and beta-diversity models to fill gaps in our knowledge of biodiversity. Ecology Letters. 2011;14(10):1043–1051. doi:10.1111/j.1461-0248.2011.01675.x.

will be run at the household level as well as the landscape (village and regency) level to study the different spatial scales.

2) Species distributions at different spatial scales

Jan Salecker (B10) is leading an analysis to study species distributions at different spatial scales, thereby pursuing hypothesis 3. The study aims at extrapolating species biodiversity patterns from plot-level data up to the whole extent of the EFForTS study area. As a first step, based on environmental variables and species biodiversity data from the 32 core plots, statistical alpha- and beta-diversity models will be developed that can then be used to predict species richness at the local scale as well as similarity between plots at broader spatial scales. In a second step, predicted and observed biodiversity patterns will be extrapolated to the whole extent of the EFForTS study area, based on continuous grids of environmental variables. This will be done using the heuristic optimization algorithm dynamicFOAM (Mokany et al. 2011, Figure 33). In addition to applying this approach to field data, an applied modelling case study will be conducted. The analysis will start with abundance data of tree, understorey plant, and bird species.

Focus 4

TITLE: **Quantifying the effects of spatial, temporal and social heterogeneity on ecological and socioeconomic functions**

REPRESENTATIVES:

Bernhard Brümmer, Teja Tscharntke

RESEARCH SUMMARY:

In the second phase of EFForTS, Focus 4 will address the heterogeneous nature of the relationships between the dimensions of sustainability in order to identify policy responses for re-balancing of ecological and socio-economic functions in Jambi. Policy measures with relevance for land use in Jambi have been devised at various levels, after discourses in very heterogeneous policy arenas, from the local and provincial level up to the international level. We currently work on the development of policy scenarios as a tool for coping with the complex interactions between policy measures, governance, and power at various levels. Such scenarios, which consist of a clearly defined set of policy interventions and assumptions on the remaining relevant conditions in the system, will provide a common way of integrating policy in various SPs (e. g., B10 Wiegand/Lay, C09 Klasen et al.) and in our focus 4.

Developing policy scenarios for such ends entails a number of steps. First, in light of our previous and ongoing research activities, the focus consortium will identify the core policy dimensions which have shaped land use in Jambi over the past decades, e.g., transmigration programmes, land rights policies, or environmental regulations. For those policy dimensions, a simplified foresight process will be done – what are the major drivers of change in the mid-term and long-term, and which plausible policy measure in the aforementioned dimensions would be suitable to address these changes? Finally, these policy measures will be combined into a set of scenarios, which can be thought of typical bundles of specific policy options. In interaction with individual SPs, these scenarios will be further refined according to the modelling needs in the specific SPs.

Such a coordinated approach across the policy relevant SPs will facilitate a comparative assessment at a later stage. In addition, the combination of individual measures into scenarios will allow to go beyond the unidimensional analysis of individual policy measures. In order to develop such policy scenarios, an initial meeting will be scheduled towards the end of this year, where input from the all CRC members will be collected. From this first collection of ideas, a set of scenarios will be distilled and distributed to all CRC members for comments and additions. Close collaboration with the projects that implement policy analysis and modelling will ensure that the final scenarios can be broadly used across different SPs.

The manuscript on Scenarios of socioeconomic-ecological trade-offs in tropical land use (Tscharntke et al.) has been revised already a few times, but needs still further re-writing.

III. ABS – Biodiversity Research, Access to Genetic Resources and Benefit Sharing

1. **Complementary research projects of counterparts and stakeholders (2017)**
2. **Capacity building workshops (2017)**
3. **CRC-ABS scholarships**
4. **Supplementary measures**

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) is the legally binding mechanism to implement access and benefit sharing. Both, Germany and the EU signed it on 23 June 2011, and the Republic of Indonesia on May 11, 2011. The DFG is one of the few funding agencies around the world that has implemented (since 2002) its own guidelines to promote the application of the principles and procedures of ABS among its applicants. It actively takes part in international discussions on ABS, particularly advocating for the requirements of basic (non-commercial) biodiversity research and for facilitating access according to article 8a[1] of the Nagoya Protocol (https://www.cbd.int/abs/text/).
In 2013, DFG approved funding of ABS measures with central research funds of the CRC 990, and since November 2013, EFForTS supports the project partners in Indonesia.

In Phase 1 (2012-2015), EFForTS awarded 33 short-term research grants to counterparts and stakeholders (LIPI, PTPN VI, PT Humusindo, BKSDA, PT REKI, Ministry of Forestry) to strengthen the research cooperation and to complement existing research activities addressing new scientific questions. In addition, a research station and a field laboratory have been set up and compensation payments were made.

In Phase 2 (2016 to 2019), the ABS funding scheme has been extended. In addition to the promotion of complementary research projects of counterparts and stakeholders, EFForTS supports capacity building workshops and awards scholarships for junior researchers at the partner universities in Indonesia. The CRC-ABS scholarships conform to the DAAD (German Academic Exchange Service) guidelines.

1 Nagoya Protocol, article 8a. Special considerations: Create conditions to promote and encourage research, which contributes to the conservation and sustainable use of biological diversity, particularly in developing countries, including through simplified measures on access for non-commercial research purposes, taking into account the need to address a change of intent for such research.

1. COMPLEMENTARY RESEARCH PROJECTS OF COUNTERPARTS AND STAKEHOLDERS IN 2017

In 2017, the Joint Management Board in Indonesia approved 30 research grants (Rp 1.390.945.500) from counterparts and stakeholders. ABS-project deliverables conform to the new funding scheme regulations by DIKTIRISTEK in Indonesia.

Research projects of counterparts funded at IPB

Counterpart / Associate		Title
Rika Raffiudin	A01	The effect of land-use change on the foraging behaviour and honey quality of the giant bee Apis dorsata in Sumatra, Indonesia
Tania June	A03	Turbulence characteristics of oil palm plantation and analysis of its momentum, energy, and water vapor fluxes using profile similarity methods
Kukuh Murtilaksono	A04	Dissolved organic carbon under oil palm plantation in small catchment of PT. Perkebunan Nusantara VI, Jambi
Anja Meriandini	B02	Isolation and selection of actinomycetes with xylanase und LPMO activity
Sri Wilarso Budi	B07	Abundant and diversity of arbuscular mycorrhizal fungi from different ecosystem in Jambi, Sumatra
Yeni A. Mulyani & Dewi M. Prawiradilaga (Biology-LIPI), Fransisca Noni Tirtaningtyas (Zoology-LIPI), Novriyanti (Fahutan-UNJA), Muhammad Nazri Janra (FMIPA-Unand)	B09	Assessment of understory bird community using mistnets and capacity building of novice birdbanders
Damayanti Buchori	B09	The effectiveness of flowering plants to conserve beneficial insects in different land-use types
Suria Darma Tarigan	B10	Relative contribution of land-use change and agriculture management practices on the ecosystem function of water flow regulation in the rainforest transformation system
Leti Sundawati	B11	Oil palm agroforestry yield and financial estimation modeling
Iskandar Z. Siregar	Z02	Developing DNA barcoding markers for Shorea species
Purnama Hidayat & Damayanti Buchori	Z02	Diversity of Butterflies (*Lepidoptera*) across rainforest transformation systems

Research projects of counterparts funded at UNJA

Muhammad Damris & Linda Handayani, Samsidar	A05	Impacts of land transformation and factors that regulate nitrogen fluxes in the soils of rainforest transformation system as a function of soil depths
Hesti Riany & Ummi Mardhiah Batubara, Zulkarnain	B02	Bacterial diversity in oil palm tree root from different location (based on soil textures) by metagenomic analysis
Mohd. Zuhdi & M. Edi Armanto, Sungkono Hening	B05	Exploring peat spatial variability using VLF method
Bambang Irawan & Hasbi Hasibuan (PT. Humusindo), Gindo Tampubolon (UNJA)	B11	Effets of trees enrichment of different oil palm ages on biodiversity of oil-palm landscape
Jauhar Khabibi & Noor Farikhah Haneda	B13	Characteristic of wood durability and wood destroyer organisms in oil plam agroforestry, rubber plantation and natural forest in Jambi province

Mirawati Yanita & Zulkifli Alamsyah, Ermawati Hamid	C01	The impact of rubber of auction market toward transmission price for farmers in Jambi Province
Rosyani & Rukaiyah Rofiq	C02	Independent smallhoder strategies to sustain RSPO certification
Edison & Ira Wahyuni	C08	Financial feasibility study of households palm oil in Sungai Bahar Subdistrict Muaro Jambi District Jambi Province
Upik Yelianti & Elva Gemita (PT. REKI)	Z01	Inventarization and conservation of indigenous orchids in Harapan Rain Forest Jambi
Revis Asra & Joko Ridho Witono (LIPI), Elva Gemita (PT. REKI)	Z01	Conservation of some species Daemonorops Spp in restoration ecosystem Indonesia

Research projects of counterparts funded at UNTAD and Universitas Brawijaya (UB)

Syahrul Kurniawan (UB)	A05	Nutrient release from decomposition of oil palm empty fruit bunches
Sri Rahayu Utami (UB)	A05	Decomposition and macro-nutrient mineralization of empty oil palm fruit bunch
Nur Edy (UNTAD)	B07	Rot disease caused by Ganoderma in oil palm and rubber plantations on Sumatra

Research projects of stakeholders funded at PT. REKI

Jomi Suhendri	Z01	Improving the utilization of homegardens of the Bathin Sembilan Tribe in the Harapan Rain Forest for a Better Food Security Status

Research projects of stakeholders funded at LIPI

Sri Rahayu & Iskandar Z Siregar (IPB)	Z01	Conservation of Hoya Species in Jambi by means eX situ conservation and public awareness

Research projects of stakeholders funded at BKSDA, the Ministry of Forestry

Marwa Prinando	Z01	Preservation valuation of Pantai Timur Mangrove Ecosystem Conservation
Elisa Septina Kuswara	Z01	Identification of potential jernang in Jebak Village, Batang Hari district

Research projects of stakeholders funded at the National Park Bukit Duabelas (TNBD)

Peri Hermansyah & Wawan Hermawan, Wulandari Mulyani	Z01	Conflict resolution encroachment to the Bukit Duabelas National Park Pematang Kabau Village, Air Hitam, sub-district- Sarolangun
Asri Buliyansih & Asep Agus Fitria	Z01	Identification on bioactive compound of medicinal herbs in Bukit Duabelas National Park

2. CAPACITY BUILDING WORKSHOPS

A Identification of Soil Fauna (Dr. Anton Potapov, University of Göttingen & Prof. Rahayu Widyastuti, Bogor Agricultural University)

Southeast Asia is known for being one of the ´biodiversity hotspots´ on Earth. However, the local fauna is little studied and this restrains progress in ecological studies. This is especially true for soil animals, where around 50% (sometimes up to 80%) of species in different groups are undescribed (according to the EFForTS survey in 2013). One of the main reasons for this situation is that there are only few soil zoologists in Indonesia describing new species. For improving this situation sharing the working experience by organizing training courses and workshops is one of the main ideas behind the international collaboration in the framework of EFForTS. These activities target at young scientists and students as potential future experts in the field.

A two-week training workshop for the identification of soil fauna was conducted at the Soil Biotechnology Division at IPB from March 20 to April 04, 2017. During the training course, a group of nine young Indonesian bachelor and master students were trained to identify major groups of the soil fauna to order or family level. Along with the practical work, introduction in specific soil fauna groups, methods of soil ecology, data analysis and work with scientific literature were provided.

A schematic identification key for the determination of soil fauna in Indonesia was developed and translated into Bahasa Indonesia (see Table 1). The pictorial key allows easy identification of all common soil invertebrates of the Indonesian fauna to the level of order or family. The manual along with other materials provided at the course serves as starting point for soil taxonomic and ecological research of young Indonesian scientists. During the practical work, students sorted animals from the research material of the B08 scientific project of EFForTS under the supervision of Anton Potapov and Rahayu Widyastuti. In total, 14.000 specimens were identified to 32 taxonomic groups (Photos 33, 34, 35).

Photo 33: Working process in the laboratory at IPB. Deseriana Bria and Remila Selvany (from left to right) sorting soil fauna from the samples of B08.

Photo 34: Working group with certificates after the course. In the back (left to the right): Endang Sulistyorini, Zaitun Ritaqwin, Dr. Anton Potapov, Remila Selvany, Winda Ika Susanti, Di Ajeng Prameswari, Keko Bahariawan. In the front (left to the right): Deseriana Bria, Sarjito, Marisi Italiensia, Prof. Rahayu Widyastuti.

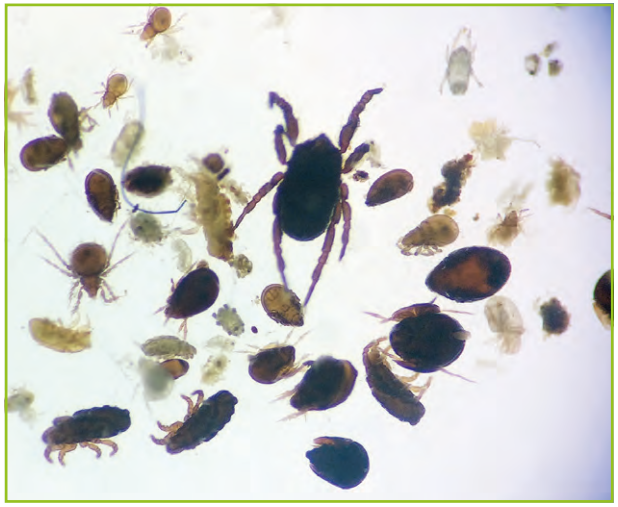


Photo 35: Soil mites under the microscope.

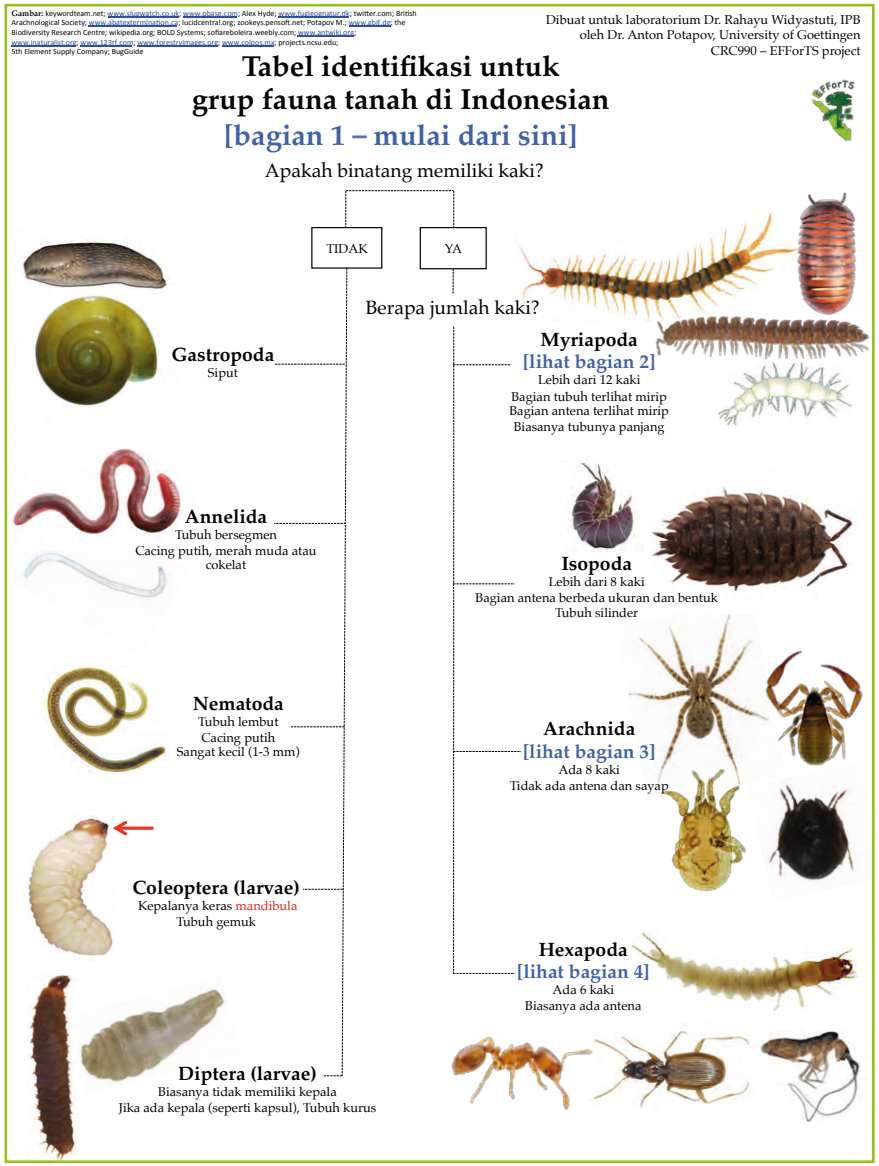


Table 1. A simplistic identification key for the determination of soil fauna in Indonesia.

B. Tropical plant identification workshop at SEAMEO BIOTROP (Dr. Katja Rembold, University of Göttingen + Royal Botanic Gardens, Kew, UK)

A one-week training workshop was conducted from 11 to 15 September 2017 at SEAMEO BIOTROP (the Southeast Asian Regional Centre for Tropical Biology) by Katja Rembold (B06) and 5 plant experts from the Royal Botanical Gardens, Kew (UK, https://www.kew.org/). The workshop was based on the annual Kew tropical plant identification and was provided for 22 participants from seven Indonesian partner institutions: LIPI, IPB, UNJA, UNTAD, UNIPA, Harapan Rainforest, and BIOTROP (Photo 36).

Photo 36: Group photo of participants of the *Tropical plant identification workshop* at SEAMEO BIOTROP, Bogor, from 11 to 15 September 2017.1st row (left to right): Lesley Walsingham, Renata Borosova, Dr. Timothy Utteridge, Dr. Katja Rembold, Dr. Jesus C. Fernandez, Dr. Andre Schuiteman, Alison Moore, Dr. Sri Sudarmiyati Tjitrosoedirdjo; 2nd row (left to right): Saiful Bachri, Dima Meiyandi, J.J. Afriastini, Mei Linda Mardalena, Dr. Deby Arifiani, Dr. Nina Ratna Djuita, Lulut Sulistyaningsih, Dwi Putri Ramadhani, Viverani Desmera, Dr. Yohana Caecilia Sulistyaningsih, Marthen Jitmau, Moh. Iqbal; 3rd row (left to right): Dirga Shabri Pradana, Dian Muh Fauzan, Agusti Randi, Prima Wahyu Kusuma Hutabarat, Deden Girmansyah, Feri Antoni, Sahlan, Petrus Rohuwa, Zuhratus Saleh, Irvan Fadli Wanda, Ade Adriadi.

The course gave the participants an overview of 38 of the most commonly encountered tropical vascular plant families, as well as an introduction to plant morphology and identification tools (program see http://www.uni-goettingen.de/en/cbd/566705.html). Through short illustrated lectures, and extensive hands-on practical sessions, Kew's botanists demonstrated the key characters for each family, sharing their expert tips for identification. Participants joined identification sessions focused on tropical Southeast Asia. An excursion to the living collections in Bogor Botanical Garden provided a chance to apply this knowledge 'in the field'. The workshop received very positive feedback and the organizers are already discussing the idea to provide a second plant identification workshop in 2018.

Photo 37: Dr. Katja Rembold (B06) at the opening of the Tropical plant identification workshop.

Photo 38: Participants of the workshop. From left to right: Saiful Bachri, J. J. Afriastini, Dima Meiyandi, Lesley Walsingham (Kew), Moh. Iqbal.

Photo 39: Tim Utteridge (Kew) giving a lecture at the Tropical plant identification workshop.

3. CRC-ABS SCHOLARSHIPS FOR TECHNICAL STAFF, MASTER AND DOCTORAL RESEARCHERS

To date, six scholarships have been awarded to master students (4) and doctoral researchers (2).

Name of student	Affiliation Indonesia	Affiliation Göttingen	Title / Abstract	Funding period
Di Ajeng Prameswari, Master student	Rahayu Widyastuti, IPB	Stefan Scheu & Anton Potapov – **B08**	*Biomass and Trophic Structure of Soil Communities in Oil Palm Biodiversity Enrichment*	Aug – Nov 2017
Project summary	Island of Sumatra experiences the highest primary rainforest cover loss in all of Indonesia (Laumonier et al., 2010; Margono et al., 2014; Miettinen et al., 2011). Application of fertilizers, pesticides and mechanical disturbance in landscapes with intensive agriculture result in the loss of soil biodiversity and connected ecosystem functions (Matson et al., 1997). The oil palm biodiversity enrichment experiment in the framework of EFForTS aims at studying the trade-offs between biodiversity and socio-economical functions of oil palm plantations with restoration plantings (Teuscher et al., 2016). The research project will study the soil fauna on the plots of oil palm biodiversity enrichment experiment across plots with systematically varied plot size, tree diversity, and tree species composition. The aim is to estimate, how these factors affect biomass and density of different trophic and taxonomic groups of soil communities.			
Winda Ika Susanti, Doctoral researcher	Rahayu Widyastuti, IPB	Stefan Scheu & Anton Potapov – **B08**	*Soil Fauna in the Lowland Rainforest and Agricultural Systems of Sumatra: Changes in Community Composition and Trophic Structure with Focus on Collembola*	Oct 2017 – Dec 2019
Project summary	The research aims at revealing changes in abundance, community structure and trophic interactions of soil fauna connected with intensive agricultural land-use such as rubber and oil palm plantations in Sumatra, Indonesia. All groups of soil invertebrates will be studied on broad taxonomic level with focus on Collembola that will be studied at high taxonomic resolution. To study trophic interactions classical methods of soil animal collecting and microscopic identification will be combined with novel instrumental techniques (stable isotope analysis).			
Hilman Fimansyah, Master student	Noor Haneda, IPB	Mark Maraun & Alena Krause – **B13**	*Diversity and ecology of oribatid mite (Acari, Oribatida) communities along a lowland rainforest transformation gradient*	Aug– Sep 2017
Project summary	Tropical lowland rain forests in Sumatra (Indonesia) have been extensively converted into oil palm plantations. Here, we investigate (1) the effect of different management intensities (two fertilizer input levels, two weeding types) on soil animal communities in oil palm plantations and (2) the effect of enrichment of oil palm plantations with native tree species on above- and belowground invertebrate animal communities (cooperation with B11). Overall, the project aims at identifying conditions allowing to ameliorate detrimental effects of conversion of tropical lowland rainforest into agricultural production systems for the structure and functioning of animal communities and to develop strategies for harmonizing conservation and socioeconomic needs. More specifically, we plan three lines of work: morphological taxonomy, molecular phylogeny, and stable isotope analyses (^{15}N; ^{13}C) for food web analyses. The work will be carried out at the facilities of the Dept. of Animal Ecology, Prof. Scheu in Göttingen.			

Amanda Mawan, Doctoral researcher	Damayanti Buchori, IPB	Stefan Scheu & Jochen Drescher – **Z02**	*Diversity, Phylogeny and Trophic Ecology of Arboreal Collembola Communities along a Lowland Rainforest Transformation Gradient*	Oct 2017 – May 2018
Project summary	Collembola are micro-arthropods which play a vital role in the leaf litter decomposer system and the formation of humus soil. In the Asian tropics, Collembola are unusually abundant on tree crowns. Dominated by the families *Entomobryidae* and *Paronellidae*, they are likely key elements to the formation of soil-filled microhabitats on tree crowns, leaf axles and epiphytic ferns. Studying the arboreal *Entomobryidae* and the *Paronellidae* along a transformation gradient from rainforest via extensive jungle rubber to monocultures of rubber and oil palm, we aim to learn about the degree and the pathways in which agricultural systems retain the ability to form humus soil. Specifically, we plan three lines of work: morphological taxonomy, molecular phylogeny and biodiversity analysis, and food web analysis via stable isotopes and fatty acids. The work will be carried out at facilities of the Dept. of Animal Ecology, Prof. Scheu in Göttingen.			
Nurul Novianti, Master student	Damayanti Buchori & Purnama Hidayat, IPB	Stefan Scheu & Jochen Drescher – **Z02**	*Development of a Rapid Molecular Biodiversity Assessment using parasitic wasps from Z02 canopy fogging*	Nov 2017 – Apr 2018
Project summary	Within Z02 "Monitoring of aboveground animal diversity", samples of arboreal arthropods have been collected via canopy fogging in the dry season of 2013, the rainy season of 2013/2014 and again in dry season of 2017. From among those samples, we identified several focus groups to work in more detail. Apart from ants (*Formicidae*), we identified six families of parasitic wasps from the *Hymenoptera* for further analysis, i. e. the *Braconidae, Ceraphronidae, Encyrtidae, Eulophidae, Platygastridae and Scelionidae*. Around 15.000 individuals of these six families were sorted to more than 1.100 morphospecies. The aim of the project is to (1) verify the sorting to morphospecies of samples from the aforementioned six Hymenoptera families by molecular means (DNA barcoding) and to (2) establish a fast and cost-effective molecular method to estimate biodiversity using the same samples as calibration.			
Rizky Nazarreta, Master student	Damayanti Buchori & Purnama Hidayat, IPB	Stefan Scheu & Jochen Drescher – **Z02**	*Establishment of a taxonomic key and electronic documentation for all ant species of the EFForTS project*	Nov 2017 – Apr 2018
Project summary	From 2012-2014, ants have been collected by at least three different scientific projects within EFForTS, i. e. B01 (leaf litter), B09 (shrub layer) and Z02 (canopy). The aim of the study is to physically combine the ant collections from all three scientific projects and establish a taxonomic key to all morphospecies. In order to do this, we will classify trait characters that distinguish between different morphospecies and work them into a taxonomic key using the software LUCID. While documenting all morphospecies photographically, we will take measurements of certain key morphological characters in order to estimate biomass distribution of ants across the four land-use systems forest, jungle rubber, rubber and oil palm. All data obtained, including abundance data, photographs, morphological measurements, traits, etc., will be deposited in an emerging database under the management of Dr. Anton Potapov (B08) with the aim to share information more transparently and efficiently among the EFForTS research members and stakeholders.			

4. SUPPLEMENTARY CAPACITY BUILDING MEASURES

Additional capacity building measures have been supported with university (UGoe) funding and by scientific projects:

a) English training courses
A three-month English training was carried out for counterparts and field assistants at UNJA from September to December 2016. Similarly, our office staff completed courses in English business training in 2017.

b) Scientific training programs
Dr. Ade Adriadi (Forestry Faculty, UNJA) participated in a training on "*Digitization of herbarium collections*" at SEAMEO BIOTROP from 19 to 25 February 2017.

Funding support by scientific projects.

c) Riko Fardiansah (field assistant, B09) participated in a six-week training course on "*Identification of Hymenoptera and Coleopteran*" at the institute of Prof. Damayanti Buchori at IPB from 24 July to 4 September 2017.

d) Herni Dwinta Pebrianti & Handriyani (field assistants, B11) participated in a one-month training on "*Seed identification*" at LIPI and SEAMEO BIOTROP in August 2017.

IV. Publications

1. **Journal articles**
2. **Other Publications**

Scientific publications of EFForTS since the last issue of newsletter no. 4, May 2016

1. JOURNAL ARTICLES

Counterpart **A02** at IPB	**Hardanto A, Röll A, Furong N, Meijide A, Hendrayanto, Hölscher D** (2017) Oil palm and rubber tree water use patterns – effects of topography and flooding *Frontiers in Plant Science 8: 452*
Counterpart **A02** at IPB	**Hardanto A, Röll A, Hendrayanto, Hölscher D** (2017) Tree soil water uptake and transpiration in mono-cultural and jungle rubber stands of Sumatra Forest *Ecology and Management 397: 67-77*
Counterpart **B04** at IPB	**Meriem S, Tjitrosoedirjo S, Kotowska M M, Hertel D, Triadiati T** (2016) Carbon and nitrogen stocks in dead wood of tropical lowland forests as dependent on wood decay stages and land-use intensity. *Annals of Forest Research 59(2): 299-310*
Counterpart **B04** at IPB	**Pransiska Y, Triadiati T, Tjitrosoedirjo S, Hertel D, Kotowska MM** (2016) Forest conversion impacts on the fine and coarse root system, and soil organic matter in tropical lowlands of Sumatera (Indonesia) *Forest Ecology and Management 379: 288-298*
Counterpart **B06** at IPB	**Rupa D, Sulistyaningsih YC, Dorli, Ratnadewi D** (2017) Identification of secretory structure, histochemistry and phytochemical compounds on Hyptis capitata Jacq. Leaves (Lamiaceae) as infction medicine. *Biotropia Vol. 24 (2)*
Counterpart **B03** at IPB	**Siregar UJ, Imran MF, Hamzah, Siregar IZ, Finkeldey R** (2016) Distribution and Local Adaptation of Two Indigenous Jelutung Trees (Dyera costulata and D. lowii) in Jambi, Indonesia: Implication for Allopatric Speciation. *Procedia Environmental Sciences 33: 393-403.*
Counterpart **B06** at IPB	**Wahyuni I, Sulistijorini S, Setiabudi S, Meijide A, Nomura M, Kreft H, Rembold K, Tjitrosoedirdjo SS, Tjitrosoedirdjo S** (2016) Distribution of invasive plant species in different land-use systems in Sumatera, Indonesia. *Biotropia 23, No 2: 124-132*
A05	**Allen KE, Corre MD, Kurniawan S, Utami SR, Veldkamp E** (2016) Spatial variability surpasses land-use change effects on soil biochemical properties of converted lowland landscapes in Sumatra, Indonesia *Geoderma 284: 42-50*
B01, A05, A03, A05, B01, B02, B04, B06, B09	**Barnes AD, Allen K, Kreft H, Corre MD, Jochum M, Veldkamp E, Clough Y, Daniel R, Darras K, Denmead LH, Haneda NF, Hertel D, Knohl A, Kotowska MM, Kurniawan S, Meijide A, Rembold K, Prabowo WE, Schneider D, Tscharntke T, Brose U** (2017) Direct and cascading impacts of tropical land-use change on multi-trophic biodiversity *Nature ecology & evolution*
B06	**Böhnert T, Wenzel A, Altenhövel, Beeretz L, Tjitrosoedirdjo SS, Meijide A, Rembold K, Kreft H** (2016) Effects of land-use change on vascular epiphyte diversity in Sumatra (Indonesia) *Biological Conservation 202: 20-29*

B08	**Bonato L, Klarner B, Widayastuti R, Scheu S** (2016) The first geophilid centipedes from Malesia: a new genus with two new species from Sumatra (Chilopoda, Geophilidae) *ZooKeys 605: 53-71.*
Focus 1 B09, C07, A05, A03, C06, C03, B01, B03, B02, B04, C01, B12, B08, B06, B13, B05	**Clough Y, Krishna VV, Corre MD, Darras K, Denmead LH, Meijide A, Moser S, Musshoff O, Steinebach S, Veldkamp E, Allen A, Barnes AD, Breidenbach N, Brose U, Buchori D, Daniel R, Finkeldey R, Harahap I, Hertel D, Holtkamp AM, Hörandl E, Irawan B, Surati Jaya IN, Jochum M, Klarner B, Knohl A, Kotowska MM, Krashevska V, Kreft H, Kurniawan S, Leuschner C, Maraun M, Melati DN, Opfermann N, Pérez-Cruzado C, Prabowo WE, Rembold K, Rizali A, Rubiana R, Schneider D, Tjitrosoedirdjo SS, Tjoa A, Tscharntke T, Scheu S** (2016) Land-use choices follow profitability at the expense of ecological functions in Indonesian smallholder landscapes *Nature Communications 7: 13137*
B09, INF, B06	**Darras K, Pütz P, Fahrurrozi, Rembold K, Tscharntke T** (2016) Measuring sound detection spaces for acoustic animal sampling and monitoring. *Biological Conservation 201:29-37*
B09	**Denmaed LH, Darras K, Clough Y, Diaz P, Grass I, Hoffmann MP, Nurdiansyah F, Fardiansah R, Tscharntke T** (2017) The role of ants, birds and bats for ecosystem functions in oil palm plantations *Ecological Society of America 98(5)*
B10, A03, A05, B01,B06, B09, C02, C03, C04	**Dislich C, Keyel AC, Salecker J, Kisel Y, Meyer KM, Auliya M, Barnes A, Corre MD, Darras K, Faust H, Hess B, Klasen S, Knohl A, Kreft H, Meijide A, Nurdiansyah F, Otten F, Pe'er G, Steinebach S, Tarigan S, Tölle M, Tscharntke T, Wiegand K** (2016) (2017) A review of the ecosystem functions in oil palm plantations, using forests as a reference system. Biological Reviews 91(3) 1469. *Biological Reviews 92(3) 1539-1569.*
C07	**Euler M, Schwarze S, Siregar H, Qaim M** (2016) Oil Palm expansion among Smallholder Farmers in Sumatra, Indonesia. *Journal of Agricultural Economics 67: 658-676.*
C07	**Euler M, Hoffmann MP, Fathoni Z, Schwarze S** (2016) Exploring yield gaps in smallholder oil palm production systems in eastern Sumatra, Indonesia *Agricultural Systems 146: 111–119*
C07	**Euler M, Krishna VV, Schwarze S, Siregar H, Qaim M** (2017) Oil palm adoption, household welfare and nutrition among smallholder farmers in Indonesia. *World Development 93: 219-235*
B09	**Ganser D, Denmead LH, Clough Y, Buchori D, Tscharntke T** (2017) Local and landscape drivers of arthropod diversity and decomposition processes in oil palm leaf axils. *Agricultural and Forest Entomollogy 19: 60-69*
C08, C07	**Gatto M, Wollni M, Asnawi R, Qaim M** (2017) Oil Palm Boom, Contract Farming, and Rural Economic Development: Village-Level Evidence from Indonesia. *World Development 95: 127–140*
B11	**Gérard A, Wollni M, Hölscher D, Irawan B, Sundawati L, Teuscher M, Kreft H** (2017) Oil-palm yields in diversified plantations: Initial results from a biodiversity enrichment experiment in Sumatra, Indonesia *Agriculture, Ecosystems & Environment 240: 253-260*
A04, C01	**Guillaume T, Holtkamp AM, Damris M, Brümmer B, Kuzyakov Y** (2016) Soil degradation in oil palm and rubber plantations under land resource scarcity *Agriculture, Ecosystems & Environment 232: 110-118*
A01	**Hapsari KA, Biagioni S, Jennerjahn TC, Reimer PM, Saad A, Achnopha Y, Sabiham S, Behling H** (2017) Environmental dynamics and carbon accumulation rate of a tropical peatland in Central Sumatra, Indonesia *Quaternary Science Reviews 169: 173-187*
A05	**Hassler E, Corre MD, Kurniawan S, Veldkamp E** (2017) Soil nitrogen oxide fluxes from lowland forests converted smallholder rubber and oil palm plantations in Sumatra, Indonesia *Biogeosciences*
B10	**Hettig E, Lay J, Sipangule K** (2016) Drivers of households' land-use decisions: A critical review of micro-level studies in tropical regions *MDPI Land 5: 32*

B01, **B08**	**Jochum M, Barnes A, Ott D, Lang B, Klarner B, Farajallah A, Scheu S, Brose U** (2017) Decreasing Stoichiometric Resource Quality Drives Compensatory Feeding across Trophic Levels in Tropical Litter Invertebrate Communities *The American Naturalist 190(1)*
B01, **B06**	**Jochum M, Barnes AD, Weigelt P, Ott D, Rembold K, Farajallah A, Brose U** (2017) Resource stoichiometry and availability modulate species richness and biomass of tropical litter macro-invertebrates *Journal of Animal Ecology*
B08, **B13**	**Klarner B, Winkelmann H, Krashevska V, Maraun M, Widyastuti R, Scheu S** (2017) Trophic niches, diversity and community composition of invertebrate top predators (Chilopoda) as affected by conversion of tropical lowland rainforest in Sumatra (Indonesia). *PLOS ONE 12(8): e0180915*
C01	**Kopp T, Brümmer B** (2017) Traders' market power along Indonesian rubber value chains *China Agricultural Economic Review, 9(2):169-187.*
C01	**Kopp T, Brümmer B, Alamsyah Z, Fatricia RS** (2017) Welfare implications of intertemporal marketing margin manipulation. *British Food Journal, 119(8):1656-1671.*
B08, B13	**Krashevska V, Klarner B, Widyastuti R, Maraun M, Scheu S** (2016) Changes in Structure and Functioning of Protist (Testate Amoebae) Communities Due to Conversion of Lowland Rainforest into Rubber and Oil Palm Plantations. *PLOS ONE 11(7): e0160179*
C07	**Krishna VV, Kubitza C, Pascual U, Qaim M** (2017) Land markets, Property rights, and Deforestation: Insights from Indonesia *World Development 99: 335-349*
C07	**Krishna VV, Euler M, Siregar H, Qaim M** (2017) Differential livelihood impacts of oil palm expansion in Indonesia *Agricultural Economics 48: 639-653*
C02, C03	**Kunz Y, Steinebach S, Dittrich C, Rosyani I, Faust H** (2017) The fridge in the forest': Historical trajectories of land tenure regulations fostering landscape transformation in Jambi Province, Sumatra, Indonesia *Forest Policy and Economics 81: 1-9*
A04	**Maranguit D, Guillaume T, Kuzyakov Y** (2016) Land-use change affects phosphorus fractions in highly weathered tropical soils *Catena 149: 385-393*
A03, A02	**Meijide A, Röll A, Fan Y, Herbst M, Niu F, Tiedemann F, June T, Rauf A, Hölscher D, Knohl A** (2017) Controls of water and energy fluxes in oil palm plantations: environmental variables and oil palm age *Agricultural and Forest Meteorology 239: 71–85*
A02, A03	**Niu F, Röll A, Hardanto A, Meijide A, Hendrayanto, Hölscher D** (2017) Rubber tree transpiration in the lowlands of Sumatra *Ecohydrology: e1882*
B09, B10	**Nurdiansyah F, Denmead LH, Clough Y, Wiegand K, Tscharntke T** (2016) Biological control in Indonesian oil palm potentially enhanced by landscape context *Agriculture, Ecosystems & Environment 232: 141-149*
B09	**Prabowo WE, Darras K, Clough Y, Toledo-Hernandez M, Arlettaz R, Mulyani YA, Tscharntke T** (2016) Bird Responses to Lowland Rainforest Conversion in Sumatran Smallholder Landscapes, Indonesia. *PLOS ONE 11, e0154876.*
B06	**Rembold K, Mangopo H, Tjitrosoedirdjo SS, Kreft H** (2017) Plant diversity, forest dependency, and alien plant invasions in tropical agricultural landscapes *Biological Conservation 213: 234-242*
A01	**Setyaningsih CA, Biagioni S, Saad A, Achnopha Y, Sabiham S, Behling H** (2017) The effect of volcanism on submontane rainforest vegetation composition: Paleoecological evidence from Danau Njalau, Sumatra (Indonesia). *The Holocene (online first)*
C02, C03	**Steinebach S, Kunz Y** (2017) Separating Sisters From Brothers: Ethnic Relations and Identity Politics in the Context of Indigenous Land Titling in Indonesia *ASEAS 10(1): 47-64*
B11	**Teuscher M, Gérard A, Brose U, Buchori D, Clough Y, Enbrecht M, Hölscher D, Irawan B, Sundawati L, Wollni M, Kreft H** (2016) Experimental Biodiversity Enrichment in Oil-Palm-Dominated Landscapes in Indonesia *Frontiers in Plant Science 7: 1538*
B09	**Toledo-Hernández M, Denmead L. H, Clough Y, Raffiudin R, Tscharntke T** (2016) Cultural homegarden management practices mediate arthropod communities in Indonesia *Journal of Insect Conservation 20: 373-382*

2. OTHER PUBLICATIONS

C02	**Alamsyah Z, Faust H** (2017) Abstracts of EFForTS Discussion Papers No. 1-19 in English and Bahasa Indonesia (2013-2016) *EFForTS discussion paper series 20.*
C07	**Krishna VV** (2016) Ennappanayum Orangutanum Thammil? ("Between Oil palm and Orangutan") *Keralakarshakan 61(7): 34-35.*
C02, A02	**Merten J, Röll A, Tarigan S, Hölscher D, Hein J** (2017) Expanding Oil Palm Cultivation in Indonesia: Changing Local Water Cycles Raises Risks of Droughts and Floods *German Development Institute, Briefing Paper 1/2017*
B05	**Urban K, Fehrmann L, Nölke N** (2016) Monitoring of fire induced land cover changes in Jambi Province, Sumatra using Sentinel-1 and Google Earth Engine *In: The science policy gap regarding informed decisions in forest policy and management. Fehrmann L, Kleinn A, Kleinn C (Eds.) (2016). Cuvillier Verlag Göttingen. ISBN: 978-3-7369-9497-3, S. 165-172*

V. Early Career Support: Education and Promotion of Junior Researchers

Research Internships in Science and Engineering - a DAAD-DFG Cooperation (https://www.daad.de/rise/en/index.html)

The RISE program promotes the advancement of junior academics by offering doctoral students of Collaborative Research Centers (CRCs) the possibility to invite and supervise undergraduate students from the United States, Canada and the UK. RISE interns work with doctoral students in the field of their research and who serve as their mentors. Funds are made available from both DAAD and the CRC / DFG.
In 2017, Christina Ani Setyaningsih – doctoral researcher of A01 has been awarded an research internship entitled *"Tracing back the millennial scale history of anthropogenic activity and the water buffalo cultural use in the Kerinci Seblat National Park in Sumatra, Indonesia".*
From May to August of this year Julia Fearon, a biologist in the third semester of study at Mount Holyoke College, South Hadley, Massachusetts, USA worked with Christina at UGoe.

1. DISSERTATIONS

Table 2. Completed dissertations of Phase 1 – University of Göttingen.

Scientific project	Name	Type of funding	Title of thesis
A02	**Niu Furong**	China Scholarship	*Transpiration by rubber and oil palm plantations: refining methods and delineating differences* (**completed 9/2016**)
A02	**Afik Hardanto**	DIKTI – Ministry Higher Education Indonesia	*Oil palm and rubber tree transpiration: topography, flooding and tree admixture in jungle rubber stands* (**completed 3/2017**)
A05	**Evelyn Hassler**	DFG	*Soil trace gas fluxes in tropical landscape converted from lowland forest to rubber and oil palm plantations* (**completed 1/2017**)
B03	**Natalie Breidenbach**	DFG	*Plant genetic diversity in tropical lowland transformation systems* (**completed 8/2016**)
B04	**Yasmin Abou Rajab**	DFG	*Shade trees in cacao agroforestry systems: influence on roots and net primary production* (**completed 9/2016**)

Scientific project	Name	Type of funding	Title of thesis
B05	**Dian Melati**	DFG	The use of remote sensing data to monitor land use systems and forest variables of the tropical rainforest landscape under transformation in Jambi Province, Sumatra, Indonesia (**completed 7/2017**)
B07	**Sahner Josephine**	DFG	Functional diversity of mycorrhizal fungi along a tropical land-use gradient (**completed**,).
B10	**Elisabeth Hettig**	DFG	*Evidence from Indonesia: Cash-crop induced land-use change. Determinants and implications* (**completed 2/2017**)
B11	**Anne Gérard**	DFG	*Impacts of biodiversity enrichment plantings in oil palm plantations: early tree performance, plant diversity effects and changes in oil palm yield* (**completed 12/2016**)
C01	**Anna Mareike Holtkamp**	DFG	*Technical and environmental efficiency of smallholder palm oil and rubber production* (**completed 8/2017**).
C02	**Barbara Beckert**	Institute of Prof. Dittrich – UGoe	*A post-frontier in transformation: land relations between access, exclusion and resistance in Jambi province, Indonesia.* (**completed 03/2017**)
C02	**Rina Mardiana**	ERASMUS	*Contesting Knowledge of Land Access Claims in Jambi, Indonesia* (**completed 4/2017**)
C04	**Katharina van Treeck**	DFG	The Role of Labor in Sustainable Development (**defense 11/2017**)
C04	**Dewi Nur Asih**	DIKTI – Ministry Higher Education Indonesia	*Essays on Food Security and Rural Transformation: Insights from Indonesia* (**completed 2/2017**)
Z02	**Fitri Yola Amandita**	Self	*DNA Barcoding of Flowering Plants in Jambi, Indonesia* (**completed 2/2016**)

Table 3. On-going dissertations Phase 2 - University of Göttingen

Scientific project	Name	Type of funding	Title of thesis
A02	**Florian Ellsäßer**	DFG	*Tree and palm water stress: thermal infrared sensing from UAVs, Indonesia* (**since 4/2016**)
A02	**Joyson Ahongshangbam**	Institute of Prof. Hölscher – UGoe	*Tree and palm water use: temporal dynamics, spatial heterogeneity and scaling – Jambi, Indonesia* (**since 4/2016**)
A04	**Nina Hennings**	DFG	*Carbon Stock, turnover and functions in heavily weathered soils under lowland rainforest transformation systems* (**since 5/2016**)
A05	**Josephus Koks**	DFG	*Conversion of forests to smallholder rubber and oil palm plantations: landscape-scale and inter-annual variations of soil greenhouse gas fluxes (GHG) and the contribution of tree-stem emission to soil GHG budget* (**since 5/2016**).
A05	**Greta Formaglio**	DFG	*Nutrient response and nutrient retention efficiency and free-living N2 fixation in large-scale oil palm plantation with different agricultural management practices* (**since 5/2016**)
A07	**Rahmi Ariani**	LPDP scholarship, Ministry of Finance, Indonesia	*Modelling the effect of land use change on soil carbon dynamics in Indonesia* (**since 10/2016)**

Scientific project	Name	Type of funding	Title of thesis
B02	**Dirk Berkelmann**	DFG	*Impact of rainforest conversion: How prokaryotic communities respond to anthropogenic land use changes* (**since 7/2016**)
B04	**Pierre-André Waite**	DFG	*Diversity of tree hydraulic strategies in intensively used and natural tropical systems* (**since 4/2016**)
B05	**Kira Urban**	DFG	*Land use patterns in Jambi* (**since 4/2016**)
B05	**Edwine Setia Purnama**	DAAD	*Development of a spatio-temporal model to describe the dynamics of forest cover changes in Jambi, Indonesia* (**since 10/2017**)
B07	**Johannes Ballauff**	DFG	*Functional diversity of mycorrhizal fungi along a tropical land-use gradient* (**since 4/2016**)
B07	**Rachmawaty Aisjah Ryadin**	LPDP scholarship, Ministry of Finance, Indonesia	*Root health and functions of oil palm and indigenous tree species as influenced by plantation management* (**since 10/2016**)
B09	**Kevin Li**	DFG	*Pollinator communities, function, and service in the oil palm landscape of Jambi Province, Indonesia* (**since 4/2017**)
B10	**Jan Salecker**	DFG	*Modelling Black Poplar (Populus nigra) – Population dynamics of riparian tree communities in a simulated floodplain* (**since 10/2016**)
B13	**Alena Krause**	DFG	*Impact of management intensity and tree enrichment of oil palm plantations on below- and aboveground invertebrates in Sumatra, Indonesia* (**since 1/2016**)
C01	**Rakhma Melati Sujarwo**	DFG	*Role of Local Traders on Rubber and Palm Oil Market in the Jambi province, Indonesia* (**since 4/2016**)
C01	**Bernhard Dalheimer**	DFG	*Dynamics of technical and environmental efficiency in rubber and oil palm land use systems* (**since 3/2017**)
C02	**Jennifer Merten**	DFG	*Regional and local governance of natural resources in a lowland rainforest transformation system* (**since 1/2016**)
C02	**Fenna Otten**	DFG	*Rural-urban relations and flows and related socio-cultural transformations in rural Jambi, Indonesia* (**since 2/2016**)
C06	**Arieska Wening Sarwosri**	DFG	*Acceptance and policing costs of ISPO and RSPO certification for oil palm farmers in Indonesia under consideration of uncertainty* (**since 3/2016**)
C07	**Christoph Kubitza**	DFG	*Determinants and welfare impacts of land-use transformation among smallholder farmers in Indonesia* (**since 4/2015**)
C07	**Daniel Naek Chrisendo**	LPDP scholarship, Ministry of Finance, Indonesia	*Impact of Land-Use Change on Household Nutrition and Other Social Welfare Indicators* (**since 4/2017**)
C08	**Miriam Romero**	DFG	*Designing incentive mechanisms for sustainable land use: The role of environmental education and extension* (**since 6/2015**)
C08	**Katrin Rudolf**	Institute of Prof. Wollni - UGoe	*Environmental preferences and economic valuation of ecosystem services of palm oil smallholders in Jambi, Sumatra* (**since 5/2016**)

Table 4. Dissertations at IPB, Bogor

Name of counterpart (IPB)	Name of researcher	Title of the thesis
Prof. Nisa Mubarik B02	Risky Hadi Wibowo	*Diversity of chitinolitic bacteria from tropical rain forest and transformation forest in Jambi and the potential of chitin degrading enzymes of Gnoderma boninense. – Keragaman Bakteri Kitinolitik Asal Hutan Hujan Tropis dan Potensi Enzim Pendegradasi Kitin pada Ganoderma Boninense.* (**completed 2017**)
Prof. Nisa Mubarik B02	Zulfarina	*Diversity of microbes enrolled in nitrogen cycling and their activities in tropical rain forest and transformation forest in Jambi. - Keragaman mikroba yang berperan dalam siklus nitrogen dan aktivitasnya di kawasan hutan tropis dan hutan transformasi jambi.* (**completed 2017**)
Prof. Tri Atmowidi B09	Andy Darmawan	*Struggle of earthworms for existence through deforestation in Bungku (Jambi) and Mount Gede (West Java).* (**completed 2016**)
Prof. Hermanto Siregar C07	Dicky Firmansyah	*Socio-economic condition of community in the National Park Bukit Duabelas and Harapan Rainforest, and the regional economy of Jambi Province.* (**on-going**)

2. MASTER THESIS

Table 5. Master studies at the University of Göttingen

Scientific project	Name of student	Title of the thesis
A03	Chandra Shekhar Badu	*Comparison of microclimate in various land-use systems in Jambi, Indonesia* (**since 7/2016**)
A07	Brani nditYo Nugroho	*Leaf gas exchange measurements of plant species in various land-use systems in Jambi province* (**since 4/2017**)
B04	Kyra Zembold	*Influence of wood density and tree height at maturity on branch embolism resistance in tropical rainforest trees* (**since 8/2017**)
B04	Mathilde Millan	*Hydraulic traits diversity of tropical plants and systems* – (**since 2/2017**)
B06	Anu Singh	*Effects of forest roads and forest degradation on invasive alien plant species in Sumatran lowland rainforest* (**completed, 2017**)
B06	Kamal Raj Aryal	*Effect of land-use change on the diversity of useful plants in Sumatra (Indonesia)* (**since 3/2017**)
B09	Alessio Paoletti	*An analysis of herpetofaunal communities of the densely farmed Jambi province, Indonesia* (**since 3/2017**)
B09	Isabelle Arimond	Diversification potential of native rainforest islands within palm oil monocultures in Jambi, Indonesia (**since 9/2016**)
B11	Birte Cordts	Seed rain in remnant forests and an oil palm plantation in Jambi province, Sumatra (**completed, 10/2016**)
B11	Jennifer Arns	Herbivory and its Effect on Tree Growth and Tree Survival in an Enrichment Planting Experiment in Jambi, Sumatra (**completed, 1/2016**)
C02	Imke Rödel	Perceptions of sustainability criteria from producer and consumer perspectives in the context of Indonesian palm oil. How does international sustainability certification influence local practices? (**since 7/2017**)

Scientific project	Name of student	Title of the thesis
C02	Katrin Martens	Social-cultural obstacles on the journey to accomplish a sustainable palm oil market in Indonesia (**7/2016**)
C08	Johanna Meinecke	Adoption of sustainable management practices in oil palm plantations by smallholder farmers in Sumatra, Indonesia (**6/2017**)

Table 6. Master studies at IPB, Bogor

Name of counterpart (IPB)	Name of student	Title of the thesis
Prof. Kukuh Murtilaksono **A04**	Gilang Sukma Putra	*The dynamics of dissolved organic carbon as influenced by the toposequence and the relationship with soil properties in the Bukit Duabelas National Park* (**on-going**)
Prof. Kukuh Murtilaksono **A04**	Ginanjar Ika Septiawan	*The dynamics of dissolved organic carbon as influenced by the toposequence and the relationship with soil properties in the Harapan Rainforest* (**on-going**)
Prof. Kukuh Murtilaksono **A04**	Achmad Adi Surya Sustama	*The dynamics of dissolved organic carbon as influenced by the toposequence and the relationship with soil properties in the Harapan Rainforest* (**on-going**)
Prof. Damayanti Buchori **Z02**	Lailatun Najmi	*Diversity of weevils (Coleoptera:Curculionidae) across land-use systems in Jambi, Sumatra* (**on-going**)
Prof. Damayanti Buchori **Z02**	M. Syaifullah Hiola	*Diversity of Staphylinid beetles in different seasons and land-use systems in Harapan Forest and Bukit Duabelas National Park* (**on-going**)
Prof. Damayanti Buchori **Z02**	Kasmiatun	*Diversity of click beetles (Coleoptera: Elateridae) in different land-use systems in Harapan Forest and Bukit Duabelas National Park* (**on-going**)
Prof. Damayanti Buchori **Z02**	Rizky Nazarreta	*Diversity and Identification of Arboreal Ants in Harapan Rainforest and Bukit Duabelas National Park Landscape, Jambi* (**on-going**)

VI. Central Meetings of the EFForTS: Workshops, Retreats, Colloquia, Symposia and Trainings

Central meetings of the CRC play an essential role for the promotion of scientific exchange between the researchers, for fostering the international collaboration with the partners in Indonesia, and for supporting young academics, for example through the organization of doctoral / postdoctoral colloquia. Moreover, international seminar series are held at IPB (ICESS) and at UNJA (UCESS) for researchers of EFForTS.

Table 7. Central meetings of EFForTS in 2016 and 2017: boards, PI, counterparts and stakeholders.

Event / Venue Date	Topic
UNJA 23 Mar 2016	- Counterpart meeting: research activities and participation in EFForTS, Phase 2.
UNJA 16 May 2016	- EFForTS-UNJA organised a half-day working group meeting with local stakeholders and counterparts to discuss both the major outcomes of Phase 1 and the planned activities of Phase 2. - About 60 representatives participated in the meeting: National Park Bukit Duabelas, PT. REKI, PT. Humusindo Makmur Sejati, PTPN VI, the police departments from Jambi city & Batanghari region, the University of Batanghari, the Agricultural Quarantine of Jambi province & the Batanghari region, BAPPEDA of the Batanghari region, PT. Djambi Waras – a rubber factory, the Balai Pengkajian Teknologi Pertanian (BPTP), and counterparts and researchers / lecturers from the University of Jambi (Photo 40). - The meeting was opened by Prof. Zulkifli Alamsyah and Dr. Bambang Irawan. Speakers of group A (Prof. Damris Muhammad), group B (Dr. Upik Yelianti) and group C (Dr. Rosyani) presented the scientific outcomes.

Photo 40: Stakeholder and counterpart meeting at UNJA on 16 May 2017.

Boards	- The annual JMB meeting was conducted on 3 Nov 2016 at UNJA. - Board meetings in Göttingen took place on 19 Jan / 18 Oct / 13 Dec 2016.
UGoe 6 Feb 2017	A half-day PI and doctoral / postdoctoral workshop was conducted with focus on interdisciplinary research activities (foci) and group activities.
IPB 15 Feb 2017	- Counterpart meeting: research activities and participation in EFForTS, Phase 2.

Boards	- The annual JMB meeting took place from 3 to 4 Apr, 2017 at UNTAD (Photo 41). - A joint board meeting (UGoe, JMB) was held on 9 Mar 2017 in Göttingen.

Photo 41: JMB meeting from 3 to 4 April 2017 at UNTAD. From left to right: Iskandar Siregar (IPB), Damayanti Buchori (IPB), Aiyen Tjoa (UNTAD), Ade Wahyunni (UNJA), Zulkifli Alamsyah (UNJA), Muhammad Basir (UNTAD), Anas M. Fauzi (IPB), Bambang Irawan (UNJA), Zulkarnain (UNJA), Marsetyo (UNTAD), Muhammad Agil (IPB), Abdul Rauf (UNTAD).

IPB, UNJA 25 to 27 May 2017	Kick off workshop, Phase 2.
UNJA 9 Jun 2017	EFForTS-UNJA organised a half-day workshop *Status quo of research activities and management issues*. - Attendants were JMB members of UNJA, counterparts, field assistants, office staff, stakeholders and junior researchers. - Presentations were given by Aiyen Tjoa (coordination), Bambang Irawan (UNJA representative), Siria Biagioni (A01), Nina Hennings (A04), Clara Zemp (B11), Jochen Drescher (Z02).
UGoe 1 to 3 Nov 2017	- A two-day annual retreat of EFForTS will take place in Göttingen (01 and 02 Nov). Focus is on the status of research and on the strategic positioning of EFForTS. - A one-day stakeholder workshop is organised on Nov 03 with focus on stakeholder relations and project-oriented collaboration / activities.

Table 8. Central meetings of EFForTS in 2016 and 2017: workshops and trainings.

Event / Date	Topic
UGoe 10 to 11 May 2016 / 5 to 6 Sep 2016	Intercultural communication and cooperation - The training was provided for the new doctoral and postdoctoral researchers of EFForTS. Focus was on the impact of culture on communication and scientific cooperation, and how to develop strategies for successful intercultural communication and cooperation.
UGoe 27 Jul 2016	INF – Research data management - A one-day workshop was carried out by INF for the new doctoral / postdoctoral researchers of EFForTS. Topics were the introduction to research data management and the usage of the EFForTS data bases EFForTS-IS and EFForTS-WebGIS.
UGoe 2 to 3 Aug 2016	INF – Statistical training - Thomas Kneib & Peter Pütz (EFForTS) and Holger Meulen (German Primate Center, UGoe) gave a two-day course on mixed models with focus on practical issues and applications of R.
8 Aug 2016 C02	Science and practice workshop at UNJA - C02 conducted a science and practice workshop with stakeholders, counterparts and researchers at UNJA on *Insight from social science research for designing a socially inclusive transformation in Jambi.*

8 Aug 2016 C02	Science and practice workshop at UNJA - Objectives / topics of the workshops were: (i) transdisciplinary exchange and knowledge creation for designing socially inclusive conservation interventions, (ii) the discussion of findings of C02 with scholars from the University of Jambi, Bogor Agricultural University, University of Göttingen and the German Development Institute, (iii) exchange on co-design of future transdisciplinary cooperation, (iv) reflections on conservation mechanisms such as REDD+ and ecosystem restoration (Photo 42).

Photo 42: Science and practice workshop Insight from social science research for designing a socially inclusive transformation in Jambi organised by C02 on 08 August 2016 at UNJA.

4 to 6 Oct 2016 B05	Forestry inventory and remote sensing workshop at IPB - Prof. Kleinn and Prof. Nengah organised a 2-day workshop entitled "*3D reconstruction of buttressed trees using a terrestrial close range photogrammetric approach*" at IPB. - Eighteen participants from IPB, the Ministry of Environment and Forestry (MoEF), partner universities in Indonesia (Yogyakarta, Makassar, Jambi) and from EFForTS learned about the fundamentals of 3D modelling and its potential application in forest sciences or ecology.
UGoe 5 to 7 Apr 2017 / 8 to 10 May 2017	First Aid training course - EFForTS Göttingen organised two special First Aid Training courses (outdoors, indoors) in April and May 2017 to train researchers doing field work in Indonesia: realistic emergency situations in the field and safety and rescue from mortal danger in outdoor areas.
UGoe 11 to 12 Oct 2017	INF – Statistical training - Peter Pütz gave a two-day course on statistic with focus on basic statistical concepts like unbiasedness, p-values, confidence intervals and hands-on exercises in R.

Table 9. Doctoral and postdoctoral colloquia / symposia at UGoe

6 Jul 2016	- A one-day symposium was held by the doctoral / postdoctoral researchers to present their interdisciplinary research and integration of results towards environmental processes, biota and ecosystem services. Results and topics are displayed on the SharePoint: https://sharepoint.uni-goettingen.de/projects/sfbindo2/SitePages/Events%20-%20Retreats%20-%20Workshops.aspx
13 Apr 2016 A02, B09	- Kevin Darras / B09: *Bird diversity, functions and services across Indonesian landuse systems.* - Niu Furong / A02: *Transpiration by oil palm and rubber plantations in Jambi, Indonesia".*
11 May 2016 INF	- Timo Gnadt / INF: *Data management - motivation and basics.* - Timo Gnadt / INF: *EFForTS-IS – access and use.* - Paul Magdon / INF & B05: *WebGIS – access and use.* - Peter Pütz/ INF: *Statistics – service and consultancy.* - Franziska Helbing / SUB: *GFBio – a short introduction.*
8 Jun 2016 B06, C07, Focus 1	- Vijesh Krishna / C07: *Farm and non-farm household survey in Jambi.* - Katja Rembold / B06: *Tropical plant identification – relevance and challenges.* - Ingo Grass / Focus 1: *Assessment of ecological and socioeconomic functions, synergies and trade-offs across tropical transformation systems.*

3 May 2017 A07, B09, B10, C01	- Rahmi Ariani / A07: *Modelling the impact of land use change on soil carbon dynamic in Indonesia.* - Kevin Li / B09: *Biodiversity enrichment, pollination, and yield in an Indonesian palm oil agroecosystem.* - Bernhard Dalheimer / C01: *Dynamics of smallholder environmental efficiency in rubber and palm oil land use systems.* - Jan Salecker / B10: *EFForTS-ABM - An agent-based model to explore ecological and socio-economic trade-offs in oil palm dominated landscapes.*
14 Jun 2017 A01, B07, C04	- Christina Setyaningsih / A01: *The effect of volcanism on the submontane rainforest vegetation composition: palaeoecological evidence from Danau Njalau, Sumatra (Indonesia).* - Sebastian Renner / C04: *Mitigating trade-offs between economic and ecological functions and services through certification.* - Aisjah Rachmawaty Ryadin / B07: *Root health and functions of oil palm and indigenous tree species as influenced by plantation management.*
5 Jul 2017 A04, C02	- Jennifer Merten / C02: *A social perspective on riparian sites.* - Nina Hennings / A04: *Stock, turnover and functions of carbon in heavily weathered soils under lowland rainforest transformation systems.*
12 Jul 2017 A07, C08	- Ashehad Ali / A07: *Improving the predictions of carbon and energy fluxes of oil palm plantations.* - Miriam Romero / C08: *Attitudes and intentions towards biodiversity enrichment in oil palm.*

Table 10. Seminar and lecture series at IPB, UNJA, UNTAD and LIPI

Speaker / SP	Title of presentation	Venue and date
Siria Biagioni A01	Palynology: materials, methods and applications in biological sciences.	UNTAD 8 Feb 2016
Miriam Romero C08	Designing incentive mechanisms for sustainable land use. The role of environmental education and extension.	UNJA 19 Feb 2016
Christoph Kubitza C07	Determinants of land-use change and impact on welfare of farm household.	UNJA 26 Feb 2016
Amanda Matson A05	Oil palm stems act as conduits of soil-derived N_2O in fertilized plantations.	UNJA 18 Mar 2016
Vijesh Krishna C07	Promoting islands of trees in oceans of oil palm plantations.	LIPI 21 Mar 2016 UNJA 8 Apr 2016
Martyna Kotowska & Bernhard Schuldt B04	Effects of rainforest conversion on carbon stocks and fluxes, litter dynamics and tree hydraulic properties in Sumatra, Indonesia.	IPB 19 Apr 2016
Katja Rembold B06	Plant diversity patterns in four land-use systems in Sumatra.	UNJA 20 Apr 2016
Jochen Drescher Z02	Ecological and socio-economic functions across tropical landuse systems after rainforest conversion.	IPB 29 Apr 2016
Dirk Hölscher A02, B11	Tree planting in oil palm plantations.	IPB 23 May 2016 UNJA 16 Sep 2016
Heiko Faust & Jonas Hein C02	Interdisciplinary research on contested landuse change in Sumatra: conceptual scaling of an inductive approach.	IPB 4 Aug 2016
Christian Stiegler A03	Ecosystem-scale assessment of the full greenhouse gas and energy balance of an oil palm plantation in Sumatra, Indonesia.	IPB 28 Sep 2016

Anton Potapov **B08**	Functioning of decomposer systems.	UNJA 7 Nov 2016
Florian Ellsäßer **A02**	Tree and palm water stress: thermal infrared sensing from unmanned aerial vehicle (UAVs).	UNJA 7 Nov 2016
Joyson Ahongshangbam **A02**	Tree and palm water use: temporal dynamics, spatial heterogeneity and scaling (Jambi, Indonesia).	UNJA 7 Nov 2016
Pierre-André Waite **B04**	Assess drought sensitivity of tropical trees and systems: Aims and methodologies of a trait-based approach.	UNJA 8 Nov 2016
Joost Koks **A05**	Forest conversion to rubber and oil palm plantation: landscape-scale and inter-annual variability of soil greenhouse gas (GHG) fluxes and the contribution of tree-stem emissions to soil GHG budget.	UNJA 14 Nov 2016
Greta Formaglio **A05**	Nutrient response and nutrient retention efficiency and free-living N2 fixation in large-scale oil palm plantation with different agricultural management practices.	UNJA 14 Nov 2016
Delphine Clara Zemp **B11**	Biodiversity enrichment in oil palm plantations.	IPB 15 Nov 2016 UNJA 8 Dec 2016
Arieska Wening Sarwosri **C06**	Acceptance & policing cost of ISPO & RSPO certification for oil palm farmers in Indonesia under consideration of uncertainty.	UNJA 17 Nov 2016
Alena Krause **B13**	Stale isotopes & oribatid mites.	UNJA 17 Nov 2016 IPB 30 Nov 2016
Isabelle Arimond **B09**	Diversification potential of native rainforest islands within oil palm monocultures in Jambi, Indonesia.	UNJA 8 Dec 2016 IPB 13 Mar 2017
Katrin Rudolf **C08**	Planting native trees in oil palm plantations: policy options.	UNJA 8 Dec 2016
Edzo Veldkamp **A05**	Impacts of deforestation for tree cash-crop plantations on soil organic carbon in the tropics.	UNJA 2 Mar 2017
Rizky Nazaretta **Z02**	Diversity and key identification of arboreal ants in Harapan rainforest and Bukit Duabelas National Park, Jambi.	IPB 13 Mar 2017
Lutz Fehrmann **B05**	Forest monitoring in context of the establishment of forest management units (KPHs).	UNJA 23 Mar 2017
Kira Urban **B05**	Landuse patterns in Jambi – an overview about ongoing research.	UNJA 23 Mar 2017
Anton Potapov **B08**	Structure and functioning of the decomposer system in lowland rainforest transformation systems.	IPB 3 Apr 2017
Alessio Paoletti **B09**	An analysis of herpetofaunal communities of the densely farmed Jambi province.	11 Apr 2017
Ashehad Ashween Ali **A07**	Development of next generation land surface models for rainforest transformation systems.	IPB 5 May 2017
Brananditya Nugroho **A07**	Leaf gas exchange measurements of plant species in various land-use systems in Jambi Province.	IPB 5 May 2017
Nina Henings **A04**	Soil carbon characteristics in riparian soils under lowland rainforest transformation systems in Sumatra, Indonesia.	IPB 12 Jun 2017
Christian Stiegler **A03**	Surface energy exchange and land-atmosphere interactions in an Indonesian oil palm plantation (Jambi, Sumatra).	UNJA 25 Aug 2017
Imke Rödel **C02**	Perceptions of sustainability in the context of Indonesian palm oil.	UNJA 13 Sep 2017

VII. Public Relation and Knowledge Transfer

I. Third Night of Science – 21 January 2017

EFForTS presented its research activities at the 3rd Night of Science at the University of Göttingen which took place on 21 January 2017 (http://www.ndw.uni-goettingen.de/files/goe_programm_ndw2017_180dpi_web.pdf). About 25.000 visitors attended this event.

Themes & activities and people involved (Photos 43, 46)**:**

1. Expositions

- Cultural corner / Jambi, Indonesia (Ella Sujarwo, Gannady Girsang, Nadia Afifah, Rahmi Ariani, Angga Emzar, Cahya Najmudinrohman).
- Collection of daily products (food and cosmetics) containing palm oil or rubber.
- Forest products (sugar cane, rattan, medicinal, fruits) (Siria Biagioni).
- Photo gallery from Jambi depicting the work of the EFForTS researchers and students in Jambi and snapshots from the different land-use systems.
- Ant specimens from the rainforest canopy (Jochen Drescher) (Photo 44).
- Honey samples from rainforest and agricultural landuse containing pollen (Siria Biagioni).

Photo 43: EFForTS Organizing Team: (from left to right) Cahya Najmudinrohman, Jochen Drescher, Fenna Otten, Christoph Kubitza, Nina Hennings, Mattia Bonazza, Kira Urban and Siria Biagioni (Foto: Ivonne Hein)

2. Games and quizzes:

- Guessing game / interactive multiple choice quiz representing groups A, B, C (Katja Rembold, Nina Hennings, Fenna Otten) (Photo 45).
- Memory game (ants, oil palm) (Jochen Drescher)
- Puzzles (ants) (Jochen Drescher).
- Interactive socio-economic questionnaire: „Vergleichen Sie sich mit einem durchschnittlichen Farmer aus Indonesien (Provinz Jambi)“ / „Compare yourself with an average farmer from Indonesia (Christoph Kubitza).

Photo 44: Ant specimens from the rainforest canopy (Jochen Drescher & Katherine Schipper) (Foto: Ivonne Hein)

Photo 45: Guessing game / interactive multiple choice quiz representing groups A, B, C (Katja Rembold, Nina Hennings, Fenna Otten) (Foto: Ivonne Hein)

Photo 46: Participants and organisers from left to right: Ivonne Hein, Barbara Wick, Stefan Scheu, Gannady, Reza, Nadia, Rahmi, Angga, Cahya, Christoph Kubitza, Fenna Otten, Herr Hesse, Ella.

II. Handbook

Dragonflies and damselflies of the EFForTS study area in Jambi and Bogor (Indonesia). Photographs by Katja Rembold (B06) and identifications by Asmus Schröter.

The booklet can be used as identification key and information basis. It can be downloaded from the website of EFForTS http://www.uni-goettingen.de/de/science/412128.html

IMPRINT

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1. Farmer cleaning his cow, Jambi province (Photo: Jochen Drescher)
2. Local rubber market in Jambi province (Photo: Jennifer Merten)
3. A village in Jambi province (Sumatra, Indonesia) covered by a thick layer of smog due to burning of vegetation (plantations, forest, …) (Photo: Mareike Holtkamp)
4. Kiosk in a village in Jambi province (Photo: Fenna Otten)

5. Celebrations (here: tug-of-war) in a village in Jambi province on occasion of the "Independence day" (17 August 1945) (Photo: Fenna Otten)
6. House and front yard in Bulian Jaya, a village in Jambi province (Photo: Fenna Otten)
7. Road conditions during the rainy season in the forest, Jambi (photo: Jochen Drescher)

All pictures taken in Jambi, Indonesia.