New Entries to IPNI Library as References

Carlson K. M. and L. M. Curran. 2014. Influence of watershed-climate interactions on stream temperature, sediment yield, and metabolism along a land use intensity gradient in Indonesian Borneo. Journal of Geophysical Research: Biogeosciences, 119:1110-1128.
Reference ID: 20688
Notes: #20688e
Abstract: Oil palm plantation expansion into tropical forests may alter physical and biogeochemical inputs to streams, thereby changing hydrological function. In West Kalimantan, Indonesia, we assessed streams draining watersheds characterized by five land uses: intact forest, logged forest, mixed agroforest, and young (<3 years) and mature (>10 years) oil palm plantation. We quantified suspended sediments, stream temperature, and metabolism using high-frequency submersible sonde measurements during month-long intervals between 2009 and 2012. Streams draining oil palm plantations had markedly higher sediment concentrations and yields, and streamtemperatures, compared to other streams. Mean sediment concentrations were fourfold to 550-fold greater in young oil palm than in all other streams and remained elevated even under base flow conditions. After controlling for precipitation, themature oil palm stream exhibited significantly greater sediment yield than other streams. Young and mature oil palm streams were 3.9°C and 3.0°C warmer than the intact forest stream (25°C). Across all streams, base flow periods were significantly warmer than times of stormflow, and these differences were especially large in oil palm catchments. Ecosystem respiration rates were also influenced by low precipitation. During an El Niño-Southern Oscillation-associated drought, the mature oil palm stream consumed a maximum 21 g O2 m-2 d-1 in ecosystem respiration, in contrast with 2.8 ± 3.1 g O2 m-2 d-1 during nondrought sampling. Given that 23% of Kalimantan's land area is occupied by watersheds similar to those studied here, our findings inform potential hydrologic outcomes of regional periodic drought coupled with continued oil palm plantation expansion.

Appiah M. R., S. T. Sackey, K. Ofori-Frimpong, and A. A. Afrifa. 1997. The consequences of cocoa production on soil fertility in Ghana: A review. Ghana Journal of Agricultural Science, 30:183-190.
Reference ID: 20689
Notes: #20689e
Abstract: Cocoa cultivation over the past 20 years has been concentrated in the Western Region of Ghana where most of the soils have been found to be unsuitable for the crop. During the 10-year period (1982-92), the estimated total amounts of major nutrients removed from the soil through the harvested beans alone were 76 000, 4 700 and 18 000 tonnes of NPK respectively. The non-use of fertilizer has led to decline in soil fertility with consequential decrease in production. The paper reviews and discusses the effects of cocoa production on soil fertility in Ghana and offers possible solution to the declined soil fertility.

Phalan, B., Onial, M., Balmford, A., and Green, R. E. Reconciling Food Production and Biodiversity Conservation: Land Sharing and Land Sparing Compared. Science 333, 1289-1291. 2011. New York, American Association for the Advancement of Science.
Reference ID: 20690
Notes: #20690e
Abstract: The question of how to meet rising food demand at the least cost to biodiversity requires the evaluation of two contrasting alternatives: land sharing, which integrates both objectives on the same land; and land sparing, in which high-yield farming is combined with protecting natural habitats from conversion to agriculture. To test these alternatives, we compared crop yields and densities of bird and tree species across gradients of agricultural intensity in southwest Ghana and northern India. More species were negatively affected by agriculture than benefited from it, particularly among species with small global ranges. For both taxa in both countries, land sparing is a more promising strategy for minimizing negative impacts of food production, at both current and anticipated future levels of production.

Hoffmann M. 2014. Understanding potential yield in the context of the climate and resource constraint to sustainably intensify cropping systems in tropical and temperate regions. University of Gottingen.
Reference ID: 20691
Notes: #20691e

IPNI. An introduction of IPNI Best Management Practice (BMP) Process Supported by Plantation Intelligence & Estate-Scale-Experimentation. 2015. Penang, Malaysia, IPNI.
Reference ID: 20692
Notes: S 8.1.1 #20692e

Ruf F. and P. S. Siswoputranto 1995. Cocoa cycles - The economics of cocoa supply, Woohead Publishing Limited, Cambridge, UK.
Reference ID: 20693
Notes: S 8.1.4 #20693

Philippine Rice Reseach Institute. Rice-based biosystems journal. Rice-based biosystems journal 1[1], 1-64. 2015. Philippines.
Reference ID: 20694
Notes: S 8.2.1 #20694
Abstract: Table of contents:
1. Effect of Azolla cover on floodwater condition and ammonia volatilization: A review
2. Isolation of methanogens and methanotrophs from a tropical lowland rice soil
3. Vermicomposting: A review of its potential use in rice-based farming system
4. Rapid generation advance in developing recombinant and backcrossed inbred lines for high temperature tolerance in rice (Oryza sativa L.)
5. Simulating potential yield of rice (Oryza sativa L.) under different nitroegn levels, climate types and projected increase in air temperature due to climate change with DSSAT ceres-rice model

Fairhurst T. and R. Hardter 2012. Palma de aceite: Manejo para rendimientos altos y sostenibles, International Plant Nutrition Institute (IPNI) and International Potash Institute (IPI).
Reference ID: 20695
Notes: S 8.1.1 #20695

IPNI 2015. IPNI research projects interpretive summaries 2013 crop year, IPNI, Georgia, USA.
Reference ID: 20696
Notes: S 39 #20696

IPNI 2015. IPNI program report 2014, IPNI, Georgia, USA.
Reference ID: 20697
Notes: S 39 #20697

IPNI 2015. IPNI style guide for communcations 2014 edition, IPNI, Georgia, USA.
Reference ID: 20698
Notes: S 39 #20698

Gerzabek M. H., R. S. Antil, I. Kogel-Knabner, H. knicker, H. Kirchmann, and G. Haberhauer. 2006. How are soil use and management reflected by soil organic matter characteristics: a spectroscopic approach. European Journal of Soil Science, 57:485-494.
Reference ID: 20699
Notes: H 1.9 #20699e
Abstract: We studied the quantitative and qualitative changes of soil organic matter (SOM) due to different land uses (arable versus grassland) and treatments (organic manure and mineral fertilizer) within an agricultural crop rotation in a long-term field experiment, conducted since 1956 at Ultuna, Sweden, on a Eutric Cambisol. The organic carbon (OC) content of the grassland plot was 1.8 times greater than that of the similarly fertilized Ca(NO3)2 treated cropped plots. The comparison of two dispersion techniques (a lowenergy sonication and a chemical dispersion which yield inherent soil aggregates) showed that increasing OC contents of the silt-sized fractions were not matched by a linear increase of silt-sized aggregates. This indicated saturation of the aggregates with OC and a limited capacity of particles to protect OC physically. Thermogravimetric analyses suggested an increase of free organic matter with increasing OC contents. Transmission FT-IR spectroscopy showed relative enrichment of carboxylic, aromatic, CH and NH groups in plots with increasing OC contents. The silt-sized fractions contained the largest SOM pool and, as revealed by 13C NMR spectroscopy, were qualitatively more influenced by the plant residue versus manure input than the clay fractions. Alkyl and O-alkyl C in the silt-sized fractions amounted to 57.4% of organic carbon in the animal manure treated plots and 50-53% in the other treatments.

IPNI. Crop plants take up (absorb) nutrients in inorganic form. 2014. Georgia, USA, IPNI.
Reference ID: 20700
Notes: H 2.8 #20700e

IPNI. Organic or inorganic: Which nutrient source is better for plants? 2014. Georgia, USA, IPNI.
Reference ID: 20701
Notes: H 2.8 #20701e

IPNI. Crop fertilization improves soil quality. 2014. Georgia, USA, IPNI.
Reference ID: 20702
Notes: H 2.8 #20702e

IPNI. Nutrient balance: Critical to crop production and environmental protection. 2014. Georgia, USA, IPNI.
Reference ID: 20703
Notes: H 2.8 #20703e

IPNI. Nutrient balance can be achieved using both inorganic and organic sources. 2014. Georgia, USA, IPNI.
Reference ID: 20704
Notes: H 2.8 #20704e

IPNI. Nutrient use and beneficial soil organisms. 2014. Georgia, USA, IPNI.
Reference ID: 20705
Notes: H 2.8 #20705e

IPNI. Ag-lime...It's good for the environment. 2014. Georgia, USA, IPNI.
Reference ID: 20706
Notes: H 2.8 #20706e

IPNI. Does fertilizer harm soil microbes? 2014. Georgia, USA, IPNI.
Reference ID: 20707
Notes: H 2.8 #20707e

IPNI. Crop plants take up (absorb) nutrients in inorganic form (Burmese). 2015. Penang, Malaysia, IPNI.
Reference ID: 20708
Notes: H 2.8 #20708e

IPNI. Organic or inorganic: Which nutrient source is better for plants? (Burmese). 2015. Penang, Malaysia, IPNI.
Reference ID: 20709
Notes: H 2.8 #20709e

IPNI. Crop fertilization improves soil quality (Burmese). 2015. Penang, Malaysia, IPNI.
Reference ID: 20710
Notes: H 2.8 #20710e

IPNI. Nutrient balance: Critical to crop production and environmental protection (Burmese). 2015. Penang, Malaysia, IPNI.
Reference ID: 20711
Notes: H 2.8 #20711e

IPNI. Nutrient balance can be achieved using both inorganic and organic sources (Burmese). 2015. Penang, Malaysia, IPNI.
Reference ID: 20712
Notes: H 2.8 #20712e

IPNI. Nutrient use and beneficial soil organisms (Burmese). 2015. Penang, Malaysia, IPNI.
Reference ID: 20713
Notes: H 2.8 #20713e

IPNI. Ag-lime...It's good for the environment (Burmese). 2015. Penang, Malaysia, IPNI.
Reference ID: 20714
Notes: H 2.8 #20714e

IPNI. Does fertilizer harm soil microbes? (Burmese). 2015. Penang, Malaysia, IPNI.
Reference ID: 20715
Notes: H 2.8 #20715e

Sopheap U., A. Patanothai, and T. M. Aye. 2012. Unveiling constraints to cassava production in Cambodia: An analysis from farmers' yield variations. International Journal of Plant Production, 6:409-428.
Reference ID: 20716
Notes: #20716e

Rosenthal D. M. and D. R. Ort. 2012. Examining Cassava's Potential to Enhance Food Security Under Climate Change. Tropical Plant Biol., 5:30-38.
Reference ID: 20718
Notes: #20718e
Abstract: Approximately 925 million people are undernourished and almost 90% of these people live in Sub-Saharan Africa (SSA), Asia and the Pacific. Sub-Saharan Africa, in particular, continues to have the highest proportion of chronically hungry individuals, where 1 in 3 (ca. 240 million) are undernourished in terms of both food quantity and nutrition. The threat of substantial changes in climate raises concerns about future capacity to sustain even current levels of food availability because climate change will impact food security most severely in regions where undernourishment is already problematic. Estimates of future climate change impacts on crops vary widely, particularly in Africa, due in part to a lack of agricultural and meteorological data. To more accurately predict future climate change impacts on food security we must first precisely assess the impact of climate change drivers on crops of food insecure regions. Recent advances in biofortification, a substantial yield gap, and an inherent potential to respond positively to globally increasing CO2 levels are synergistic and encouraging for cassava in an otherwise bleak global view of the future of food security in the developing world.

Fermont A. M., P. J. A. van Asten, P. Tittonell, M. T. van Wijk, and K. E. Giller. 2009. Closing the cassava yield gap: An analysis from smallholder farms in East Africa. Field Crops Research, 112:24-36.
Reference ID: 20719
Notes: #20719e
Abstract: Cassava yields in Africa are small and it remains unclear which factors most limit yields. Using a series of farm surveys and on-farm and on-station trials in Uganda and western Kenya, we evaluated the importance of abiotic, biotic and associated crop management constraints for cassava production in a range of socio-economic settings as found in smallholder farms in the region. Average yields under farmer management were 8.6 t ha(-1),but these were more than doubled to 20.8 t ha(-1) by using improved crop establishment, improved genotypes and 100-22-83 kg ha(-1) of single-nutrient N-P-K fertilizers. A farm survey revealed large yield differences between farms. Less endowed farmers harvested less cassava per unit area than better endowed farmers (difference of 5.9 and 9.7 t ha(-1) in Kenya and Uganda, respectively); differences were associated with less access to labour, poorer soils, and premature harvesting by less endowed farmers. Analysis of 99 on-farm and 6 on-station trials showed that constraints for cassava production varied strongly between sites and years. Poor soil fertility, early water stress and sub-optimal weed management limited cassava production by 6.7, 5.4 and 5.0 t ha(-1), respectively, when improved crop establishment and genotypes were used. Pests and diseases were relatively unimportant, while weed management was particularly important in farmer fields during a dry year in Kenya (yield gap of 11.6 t ha(-1)). The use of complementary analytical tools such as multiple regression and boundary line analysis revealed that many fields were affected by multiple and interacting production constraints. These should be addressed simultaneously if significant productivity improvements are to be achieved. This will be more difficult for less endowed than for better endowed farm households, since the former lack social and financial capital to improve management.

Prudencio C. Y., G. C. Orkwor, and A. F. K. Kissiedu. 1992. The Relationships Between Cassava Variety Set Characteristics, Farmers Food Security Objectives, Environmental And Socioeconomic Conditions In Africa. Agricultural Systems, 39:387-408.
Reference ID: 20720
Notes: #20720e
Abstract: Hypotheses with respect to the cassava variety selection criteria used by farmers in order to satisfy their food security objectives under various environmental and socio-economic conditions were formulated and tested with data from the Collaborative Study of Cassava in Africa (COSCA). The characteristics of the sets of cassava varieties grown by farmers and their adjustment pattern over time depend mainly on production objectives which are mostly dictated by environmental and socio-economic conditions. Early and late maturing varieties with good ground storability are selected by farmers to bridge the food gap during the hungry season; relatively late maturing varieties with good ground storability and low pest and disease susceptibility are selected to constitute backstop food reserves where the environmental risk of crop failure is a major concern; early maturing varieties with high yield and high dry matter content are selected to adjust to low or declining resource base per capita in high population density or high market demand areas. Farmers in low population density areas of the humid forest zones use, in addition, ability to compete effectively with weeds as a major selection criterion. In general the

sweet/bitter character of cassava varieties appears to be a less important selection criterion to farmers.

Nelson P. N., M. Banabas, N. I. Huth, and M. J. Webb. 2013. Quantifying trends in soil fertility under oil palm: practical challenges and approaches.
Reference ID: 20721
Notes: H 8.1.1.8 #20721
Abstract: Monitoring of trends in soil fertility in space and time relies on sampling techniques that adequately represent soils in the field. Representative sampling in oil palm plantations is challenging due to high spatial and temporal variability. Currently used soil sampling techniques, such as taking samples from the weeded circle and frond pile, have several defiencies, both of the purposes of research and monitoring by managers. Here, we present a) a practical method for obtaining representative composite soil samples, and b) an approach for monitoring likely trends intwo important soil fertility parameters, acidity and organic matter content, without the need for sampling the soil. The soil sampling method involves taking many samples along a linear transect that crosses 4 or 6 rows and combining them into one sample. It accounts for tree-scale variablity and enables monitoring across crop cycles. We suggest such sampling be carried out every 5-10 years by plantation managers. The approach for monitoring likely trends in soil acidity and organic matter content estimates the principal drivers of changes in these parameters:'net acid addition rate' and organic matter addition rate. It uses data routinely collected by plantation managers, and a crop system model. We suggest such estimates could be carried out annually by plantation managers, enabling them to predict trends in soil fertility and likely effects of existing or proposed management practices.

Ringrose-Voase, A. J., Wong, M. J. T., and Winston, E. C. Soil fertility evaluation/advisory service in Negara Brunei Darussalam - Fertilizer and lime calculator manual. 1-41. 2008. Australia, CSIRO Land and Water.
Reference ID: 20722
Notes: H 21 #20722

Abood S. A., J. S. H. Lee, Z. Burivalova, J. Gacrcia-Ulloa, and L. P. Koh. 2015. Relative Contributions of the Logging, Fiber, Oil Palm, and Mining Industries to Forest Loss in Indonesia. A Journal of the Society for Conservation Biology, 8:58-67.
Reference ID: 20723
Notes: #20723e
Abstract: Indonesia contributes significantly to deforestation in Southeast Asia. However, much uncertainty remains over the relative contributions of various forest-exploiting sectors to forest losses in the country. Here, we compare the magnitudes of forest and carbon loss, and forest and carbon stocks remaining within oil palm plantation, logging, fiber plantation (pulp and paper), and coal mining concessions in Indonesia. Forest loss in all industrial concessions, including logging concessions, relate to the conversion of forest to nonforest land cover. We found that the four industries accounted for 44.7% (6.6 Mha) of forest loss in Kalimantan, Sumatra, Papua, Sulawesi, and Moluccas between 2000 and 2010. Fiber plantation and logging concessions accounted for the largest forest loss (1.9Mha and 1.8Mha, respectively). Although the oil palm industry is often highlighted as a major driver of deforestation, it was ranked third in terms of deforestation (1Mha), and second in terms of carbon dioxide emissions (1,300-2,350 Mt CO2). Crucially, 34.6% (26.8 Mha) of Indonesia's remaining forests is located within industrial concessions, the

majority of which is found within logging concessions (18.8 Mha). Hence, future development plans within Indonesia's industrial sectors weigh heavily on the fate of Southeast Asia's remaining forests and carbon stocks.

Abram N. K., P. Xofis, J. Tzanopoulos, D. C. MacMillan, M. Ancrenaz, R. Chung, L. Peter, R. Ong, I. Lackman, B. Goossens, L. Ambu, and A. T. Knight. 2014. Synergies for Improving Oil Palm Production and Forest Conservation in Floodplain Landscapes. Plos One, 9:1-12.
Reference ID: 20724
Notes: #20724e
Abstract: Lowland tropical forests are increasingly threatened with conversion to oil palm as global demand and high profit drives crop expansion throughout the world's tropical regions. Yet, landscapes are not homogeneous and regional constraints dictate land suitability for this crop. We conducted a regional study to investigate spatial and economic components of forest conversion to oil palm within a tropical floodplain in the Lower Kinabatangan, Sabah, Malaysian Borneo. The Kinabatangan ecosystem harbours significant biodiversity with globally threatened species but has suffered forest loss and fragmentation. We mapped the oil palm and forested landscapes (using object-based-image analysis, classification and regression tree analysis and on-screen digitising of high-resolution imagery) and undertook economic modelling. Within the study region (520,269 ha), 250,617 ha is cultivated with oil palm with 77% having high Net-Present-Value (NPV) estimates ($413/ha-yr-$637/ha-yr); but 20.5% is under-producing. In fact 6.3% (15,810 ha) of oil palm is commercially redundant (with negative NPV of $-299/ha-yr-$-65/ha-yr) due to palm mortality from flood inundation. These areas would have been important riparian or flooded forest types. Moreover, 30,173 ha of unprotected forest remain and despite its value for connectivity and biodiversity 64% is allocated for future oil palm. However, we estimate that at minimum 54% of these forests are unsuitable for this crop due to inundation events. If conversion to oil palm occurs, we predict a further 16,207 ha will become commercially redundant. This means that over 32,000 ha of forest within the floodplain would have been converted for little or no financial gain yet with significant cost to the ecosystem. Our findings have globally relevant implications for similar floodplain landscapes undergoing forest transformation to agriculture such as oil palm. Understanding landscape level constraints to this crop, and transferring these into policy and practice, may provide conservation and economic opportunities within these seemingly high opportunity cost landscapes.

Andrianto, A., Sedik, B. F., Waridjo, H., Komarudin, H., and Obidzinski, K. The impacts of oil palm plantations on forests and people in Papua: A case study from Boven Digoel District. 1-24. 2014. Bogor, Indonesia, Center for International Forestry Research.
Reference ID: 20725
Notes: #20725e

Azhar B., D. Lidenmayer, J. Wood, J. Fischer, A. Manning, C. McElhinny, and M. Zakaria. 2013. Contribution of illegal hunting, culling of pest species, road accidents and feral dogs to biodiversity loss in established oil-palm landscapes. Wildlife Research, 40:1-9.
Reference ID: 20726
Notes: #20726e
Abstract: Context. Understanding the ecological impacts of the palm-oil industry on native fauna requires information on anthropogenic threats that may cause species decline or local extinction.

Aim. The main aim of the study was to assess wildlife deaths caused by illegal hunting, road accidents and introduced predators in established oil-palm landscapes in Peninsular Malaysia.

Methods. Between April and October 2009, we interviewed 362 oil-palm workers at 36 sites, including large industrial estates and semi-traditional smallholdings.

Key results. Our results showed that (1) illegal hunting by oil-palm workers in different oil-palm management systems was not statistically significant (P = 0.097), (2) native fauna were more often destroyed as pests in smallholdings than in conventional and eco-friendly plantation estates (P = 0.005), (3) non-local poachers conducted illegal activity more often in smallholdings than in conventional and eco-friendly plantation estates (P = 0.011), (4) road accidents were reported to kill more native fauna in conventional plantation estates than in smallholdings and eco-friendly plantation estates (P < 0.001) and (5) feral dogs were reported as killing more native fauna in eco-friendly plantation estates than in conventional plantation estates and smallholdings (P = 0.034).

Conclusion. In addition to the conversion of native forest to oil-palm monocultures, various other anthropogenic threats can have a substantial effect on wildlife in oil-palm landscapes.

Implications. To improve the conservation value of oil-palm landscapes, we recommend that palm-oil stakeholders should implement anti-poaching patrols, organise conservation programs to educate workers, reduce vehicle speeds on roads within oil-palm landscapes, and control local populations of feral dogs.

Boucher D., S. Roquemore, and E. Fitzhugh. 2013. Brazil's success in reducing deforestation. Tropical Conservation Science, 6:426-445.
Reference ID: 20727
Notes: #20727e
Abstract: Over the past several years, the rate of deforestation in the Brazilian Amazon has dropped by more than two-thirds. This reduction has been achieved despite high beef and soy prices, which in previous years had pushed deforestation upward, and during the same time that Brazil made important social progress in reducing poverty, hunger and inequality. The reduction in global warming pollution that this represents is the largest contribution so far by any country, rich or poor. Several factors are responsible for this accomplishment. They include: government policies and enforcement actions by prosecutors, on both the federal and state levels; the incentive created by Norway's pledge of up to $1 billion in results-based compensation through the Amazon Fund; the strong and concerted pressure exerted

by Brazilian civil society on the government and the soy and beef industries; and the positive response by those industries, resulting in the 2006 soy and 2009 beef moratoria. Political leaders, such as President Luis In‡cio Lula da Silva and especially Minister of the Environment/2010 Green Party presidential candidate Marina Silva, can also claim an important share of the credit. While success is by no means assured, what has been achieved so far is already quite impressive, and makes it possible to envision the reduction of Amazon deforestation and forest degradation to zero within the next decade.

Basiron Y. 2002. Palm oil and its global supply and demand prospects. Oil Palm Industry Economic Journal, 2:1-10.
Reference ID: 20728
Notes: #20728e
Abstract: The paper outlines the global palm oil situation and highlights the developments in the Malaysian and Indonesian palm oil industry. Palm oil has played a positive role in the world oils and fats supply and demand equation largely due to its techno-economic advantages and versatility as well as some of the developments in the world in relation to security of supply, health and environment. The paper will also discuss the various challenges confronting palm oil in the world market, namely self-sufficiency policies by developing countries, crop subsidies by developed countries, stringent standards and quality for trade, non-tariff technical barriers and effects of exchange rate variations.

Burke P. J. and B. P. Resosudarmo. 2012. Survey of recent developments. Bulletin of Indonesia Economic Studies, 48:299-324.
Reference ID: 20729
Notes: #20729e
Abstract: The Indonesian economy is maintaining its momentum at a time of ongoing uncertainty in the global economy and slowing economic growth in China. Strong domestic demand saw output grow by 6.4% over the year to June, despite a steep fall in net exports. Inflation is safely within Bank Indonesia's target range, although food prices have increased relatively quickly. The current account deficit widened to 3.1% of GDP in the June quarter due to continued growth in imports and falling prices for commodity exports. The trade environment has deteriorated in 2012, and new divestment and domestic processing requirements are likely to further reduce investor interest in the mining sector.

President Yudhoyono has recently made several speeches calling for a 'green growth agenda'. Some progress has been seen in slowing deforestation and in establishing mechanisms for facilitating payments to reduce emissions from deforestation, but loss of natural forests remains rapid. Carbon dioxide emissions from energy are growing quickly, stoked by increasing use of coal. The proposed 2013 budget continues to be heavily burdened by energy subsidies, which encourage over-consumption of fossil fuels. In most respects, therefore, the business-asusual trajectory of the Indonesian economy is unlikely to be particularly green. A barrier to subsidy reform is its perceived unpopularity, including the threat of public protests such as those witnessed in March. To gauge current opinion we carried out a survey of Jakarta-based university students. The results indicated majority support for the removal of fuel subsidies, but some respondents said they would protest against fuel subsidy reductions, highlighting the politically sensitive nature of the issue.

Indonesia has witnessed booms in the coal and palm oil sectors in recent years, becoming the world's largest exporter of both commodities. We review the benefits from these two booms and the tensions between the development of these sec tors and environmental goals. We also review the tourism sector, which remains relatively under-developed outside Bali. Tourism is a potential source of long-run growth that may be aligned with a green economy. The development of the sector would be aided by infrastructure improvements and a renewed focus on the conservation of natural assets.

Busch J., K. Ferretti-Gallon, J. Engelmann, M. Wright, K. G. Austin, F. Stolle, S. Turubanova, P. V. Potapov, B. Margono, M. C. Hansen, and A. Baccini. 2015. Reductions in emissions from deforestation from Indonesia's moratorium on new oil palm, timber, and logging concessions. PNAS, 112:1328-1333.
Reference ID: 20730
Notes: #20730e
Abstract: To reduce greenhouse gas emissions from deforestation, Indonesia instituted a nationwide moratorium on new license areas ("concessions") for oil palm plantations, timber plantations, and logging activity on primary forests and peat lands after May 2011. Here we indirectly evaluate the effectiveness of this policy using annual nationwide data on deforestation, concession licenses, and potential agricultural revenue from the decade preceding the moratorium.We estimate that on average granting a concession for oil palm, timber, or logging in Indonesia increased site-level deforestation rates by 17-127%, 44-129%, or 3.1-11.1%, respectively, above what would have occurred otherwise. We further estimate that if Indonesia's moratorium had been in place from 2000 to 2010, then nationwide emissions from deforestation over that decade would have been 241-615 MtCO2e (2.8-7.2%) lower without leakage, or 213-545 MtCO2e (2.5-6.4%) lower with leakage. As a benchmark, an equivalent reduction in emissions could have been achieved using a carbon price-based instrument at a carbon price of $3.30-7.50/tCO2e (mandatory) or $12.95-19.45/tCO2e (voluntary). For Indonesia to have achieved its target of reducing emissions by 26%, the geographic scope of the moratorium would have had to expand beyond new concessions (15.0% of emissions from deforestation and peat degradation) to also include existing concessions (21.1% of emissions) and address deforestation outside of concessions and protected areas (58.7%of emissions). Place-based policies, such as moratoria, may be best thought of as bridge strategies that can be implemented rapidly while the institutions necessary to enable carbon price-based instruments are developed.

Byerlee D., J. Stevenson, and N. Villoria. 2014. Does intensification slow crop land expansion or encourage deforestation? Global Food Security, 3:92-98.
Reference ID: 20731
Notes: #20731e
Abstract: The role of intensification in minimizing crop land and slowing deforestation is often disputed. We make a broad distinction between technology-induced and market-induced intensification. We find evidence at the local level that technical progress in a few cases may induce land expansion although much depends on where the technical change occurs (near the forest frontier or away from it) and the type of market (local or global).At a global level, technology-driven intensification is strongly land saving although deforestation in specific regions is likely to continue to occur. Market-driven intensification, however, is often a major cause of land expansion and deforestation especially for export commodities in times of high

prices.Beyond land saving, the type of intensification matters a lot for environmental outcomes. Finally, technology-driven intensification by itself is unlikely to arrest deforestation unless accompanied by stronger governance of natural resources.

Carrasco, L. R., Larrosa, C., Milner-Gulland, E. J., and Edwards, D. P. A double-edged sword for tropical forests. Science 346[6205], 38-40. 2014. AAAS.
Reference ID: 20732
Notes: #20732e

Castiblanco C., A. Etter, and A. Ramirez. 2015. Impacts of oil palm expansion in Colombia: What do socio economic indicators show? Land Use Policy, 44:31-43.
Reference ID: 20733
Notes: #20733e
Abstract: The impact of energy crops and biofuel production on development, social welfare and conservation of ecosystems and ecological services has constituted a heated debate. At the center of these controversies is the development of agro-industrial plantations, particularly oil palm. To contribute to a better informed debate, we use existing data to analyze the socio economic impacts of the expansion of oil palm plantations in Colombia, the major producer of Latin America. We used the official database of socio economic indicators of municipalities for the period 1993-2009, and apply several descriptive and multivariate analyses. The results of the study confirm several issues found in the international literature: oil palm municipalities present lower levels of unmet basic needs and bigger fiscal incomes in comparison to municipalities where this crop is not cultivated. However, in Colombia depending on the region and time period, violence and land tenure concentration are higher in oil palm municipalities, which may help to explain the persistence of inequity and poverty in some areas.

Chiti T., E. Grieco, L. Perugini, A. Rey, and R. Valentini. 2014. Effect of the replacement of tropical forests with tree plantations on soil organic carbon levels in the Jomoro district, Ghana. Plant and Soil, 375:47-59.
Reference ID: 20734
Notes: #20734e
Abstract: Background and aims In the Jomoro district in Ghana, tree plantations were the first cause of deforestation in the past, drastically reducing the area occupied by primary forests. The aim of this study was to quantify soil organic carbon (SOC) losses due to a change in land use from primary forest to tree plantations (cocoa, coconut, rubber, oil palm) on the different substrates of the district. Secondary forests and mixed plantations were also included in the study.

Methods Soils were sampled at different depths up to 100 cm along a series of chronosequences in each of the three substrates (Granite, Lower Birrimian and Tertiary Sands) present in the area. Results The highest SOC losses in the 0Ð30 cm layer were caused by the conversion of primary forests to tree plantations: cocoa □|61 % of the original SOC stock, coconut □|55 %, rubber □|35 % and oil palm 28 %, while mixed plantations and secondary forests showed a loss of 23 % and 21 % of the original SOC stock, respectively. C losses were less apparent from the entire profile (to a depth of 100 cm).

Conclusions All conversions to tree plantations caused substantial SOC losses, comparable to the conversion of forests to agricultural systems. Secondary forests

and mixed plantations were the only sustainable land uses that restricted SOC losses considerably.

IPNI. Better crops with plant food Vol.99 (2015, No.1). Better Crops With Plant Food 99[1], 1-31. 2015. IPNI.
Reference ID: 20735
Notes: #20735e

Deininger K. 2013. Global land investments in the bio-economy: evidence and policy implications. Agricultural Economics, 44:115-127.
Reference ID: 20736
Notes: #20736e
Abstract: For countries dependent on agriculture, the recent wave of investor interest in farmland could, in principle, help set in motion a virtuous cycle of economic growth and poverty reduction. A large literature documenting failure of such investments documents the risks involved. To appreciate associated opportunities and challenges, we review past experience, quantify country-level potential for area expansion versus intensification, and identify determinants of countries' attractiveness for investors in the initial stages of the 'land rush'. The fact that weak land governance seems to increase, rather than reduce, land demand justifies an emphasis on improving institutions, transparency, and accountability while at the same time providing concrete suggestions for policy and research.

Bakewell D. and M. Donysius. 2014. Forest fragmentation in oil palm plantations: impacts on biodiversity and options for mitigation. Journal of Oil Palm, Environment & Health, 5:55-62.
Reference ID: 20737
Notes: #20737e
Abstract: The impacts of forest fragmentation on biodiversity, such as population isolation, edge effect and ecosystem weakening, are summarized. Two basic approaches to mitigation of these impacts in palm oil landscapes are outlined: Land-sparing and Land-sharing. The Land-sparing approach argues that forest fragments in most oil palm landscapes are of negligible conservation value, and that, instead of trying to increase the biodiversity value of these, money and effort would be better spent investing in protection and management of large contiguous areas of forest offsite, such as are available in biobank projects. Arguments for adopting a Land-sharing approach include protection of ecosystem functions, benefits to local communities, and protection of extant high conservation value species populations. An example of the latter approach is showcased - that of the Kinabatangan Corridor of Life Project in Sabah. Which of these two approaches individual companies should adopt will depend on consideration of local and landscape-level factors, and these can be determined by a thorough biodiversity assessment of the plantation and surrounding ecosystem.

Edwards F. A., D. P. Edwards, T. H. Larsen, W. W. Hsu, S. Benedick, A. Chung, V. Khen, D. S. Wilcove, and K. C. Hamer. 2014. Does logging and forest conversion to oil palm agriculture alter functional diversity in a biodiversity hotspot? Animal Conservation, 17:163-173.
Reference ID: 20738
Notes: #20738e

Abstract: Forests in Southeast Asia are rapidly being logged and converted to oil palm. These changes in land-use are known to affect species diversity but consequences for the functional diversity of species assemblages are poorly understood. Environmental filtering of species with similar traits could lead to disproportionate reductions in trait diversity in degraded habitats. Here, we focus on dung beetles, which play a key role in ecosystem processes such as nutrient recycling and seed dispersal. We use morphological and behavioural traits to calculate a variety of functional diversity measures across a gradient of disturbance from primary forest through intensively logged forest to oil palm. Logging caused significant shifts in community composition but had very little effect on functional diversity, even after a repeated timber harvest. These data provide evidence for functional redundancy of dung beetles within primary forest and emphasize the high value of logged forests as refugia for biodiversity. In contrast, conversion of forest to oil palm greatly reduced taxonomic and functional diversity, with a marked decrease in the abundance of nocturnal foragers, a higher proportion of species with small body sizes and the complete loss of telecoprid species (dung-rollers), all indicating a decrease in the functional capacity of dung beetles within plantations. These changes also highlight the vulnerability of community functioning within logged forests in the event of further environmental degradation

Fargione, J., Hill, J., Tilman, D., Polasky, S., and Hawthorne, P. Land clearing and the biofuel carbon debt. Science 319, 1235-1238. 2008.
Reference ID: 20739
Notes: #20739e
Abstract: Increasing energy use, climate change, and carbon dioxide (CO2) emissions from fossil fuels make switching to low-carbon fuels a high priority. Biofuels are a potential low-carbon energy source, but whether biofuels offer carbon savings depends on how they are produced. Converting rainforests, peatlands, savannas, or grasslands to produce food crop-based biofuels in Brazil, Southeast Asia, and the United States creates a "biofuel carbon debt" by releasing 17 to 420 times more CO2 than the annual greenhouse gas (GHG) reductions that these biofuels would provide by displacing fossil fuels. In contrast, biofuels made from waste biomass or from biomass grown on degraded and abandoned agricultural lands planted with perennials incur little or no carbon debt and can offer immediate and sustained GHG advantages.

Fargione J. E., R. J. Plevin, and J. D. Hill. 2010. The Ecological Impact of Biofuels. Annual Review of Ecology, Evolution and Systematics, 41:351-377.
Reference ID: 20740
Notes: #20740e
Abstract: The ecological impact of biofuels is mediated through their effects on land, air, and water. In 2008, about 33.3 million ha were used to produce foodbased biofuels and their coproducts. Biofuel production from food crops is expected to increase 170% by 2020. Economic model estimates for landuse change (LUC) associated with food-based biofuels are 67-365 ha 10.6 l.1, leading to increased greenhouse gas emissions for decades compared to business as usual. Biodiversity is reduced by about 60% in U.S. corn and soybean fields and by about 85% in Southeast Asian oil palm plantations compared to unconverted habitat. Consequently, the largest ecological impact of biofuel production may well come from market-mediated LUC. Mitigating this impact requires targeting biofuel production to degraded and abandoned cropland and rangeland; increasing crop

yields and livestock production efficiency; use of wastes, residues, and wildlife-friendly crops; and compensatory offsite mitigation for residual direct and indirect impacts.

Frazao L. A., K. Paustian, C. E. P. Cerri, and C. C. Cerri. 2014. Soil carbon stocks under oil palm plantations in Bahia State, Brazil. Biomass & Bioenergy, 62:1-7.
Reference ID: 20741
Notes: #20741e
Abstract: Oil palm (Elaeis guineensis Jacq.) has been cited as the main raw material for biodiesel production in Brazil. This oilseed is cultivated in the Brazilian Atlantic coast in mixed 'spontaneous' agroforest systems and in commercial plantations. Different oil palm cultivations derived from native rain forest can modify the soil organic carbon (C) dynamics. The aim of our study was to evaluate the changes in soil organic carbon (SOC) stocks after conversion of Atlantic forest into oil palm production in Bahia State, Brazil. Soil samplings were carried out in May 2008 and February 2009 in four areas: Native Atlantic Rain Forest (NARF), a mixed secondary forest/agroforestry Spontaneous System (SPSY), oil palm cultivated during 23 (OP23) and 34 years (OP34). The spatial variability of C and nitrogen (N) contents and the differences in soil C stocks between the avenues (inter-rows) and frond piles in oil palm areas were evaluated. We found the highest soil C contents in the region next the oil palm base (1.22% in OP23 and 1.49% in OP34). The soil C stocks were higher in frond piles (1.7 times in OP23 and 2.6 times in OP34) than in the avenues, due to inputs of soil organic matter by pruned fronds. The soil C stocks adjusted for a mass equivalent and different clay content decreased in SPSY. The OP23 area showed lower SOC stocks compared with native system. However, OP34 area showed the highest C stocks among the areas evaluated with an increase of 25% of the amount of SOC storage found under native vegetation. We found SOC storage of 34.7 Mg ha1 and 66.6 Mg ha1 under OP23 and OP34, respectively, indicating an increase of soil C stocks in oil palm plantations over time.

Gatto M., M. Wollni, and M. Qaim. 2015. Oil palm boom and land-use dynamics in Indonesia: The role of policies and socioeconomic factors. Land Use Policy, 46:292-303.
Reference ID: 20742
Notes: #20742e
Abstract: We investigate land-use dynamics in Jambi, Sumatra, one of the hotspots of Indonesia's recent oil palmboom. Data from a structured village survey are used to analyze the role of socioeconomic and policyfactors. Oil palm is partly grown on large plantations, but smallholders are also involved to a significantextent. We find that, in spite of considerable oil palm expansion, rubber remains the dominant crop. Mostof the oil palm growth takes place on previous fallow and rubber land. Oil palm has not been a majordriver of deforestation. Much of the forest in Jambi was cleared more than 20 years ago, and rubber wasan established cash crop long before the oil palm boom started. However, oil palm growth occurs inlocations with ongoing logging activities, so indirect effects on deforestation are possible. The Indone-sian government's transmigration program of the 1980s and 1990s was instrumental for the start andspread of oil palm in Jambi. Some autochthonous villages have adopted oil palm. But oil palm adoption inautochthonous villages started later and happens at a slower pace than in the villages of the transmigrantsfrom Java.

Gaveau D. L. A., S. Wich, J. Epting, D. Juhn, M. Kanninen, and N. Leader-Williams. 2009. The future of forests and orangutans (Pongo abelii) in Sumatra: predicting impacts of oil palm plantations, road construction, and mechanisms for reducing carbon emissions from deforestation. Environmental Research Letters, 4:1-11.
Reference ID: 20743
Notes: #20743e
Abstract: Payments for reduced carbon emissions from deforestation (RED) are now attracting attention as a way to halt tropical deforestation. Northern Sumatra comprises an area of 65 000 km2 that is both the site of Indonesia's first planned RED initiative, and the stronghold of 92% of remaining Sumatran orangutans. Under current plans, this RED initiative will be implemented in a defined geographic area, essentially a newly established, 7500 km2 protected area (PA) comprising mostly upland forest, where guards will be recruited to enforce forest protection. Meanwhile, new roads are currently under construction, while companies are converting lowland forests into oil palm plantations. This case study predicts the effectiveness of RED in reducing deforestation and conserving orangutans for two distinct scenarios: the current plan of implementing RED within the specific boundary of a new upland PA, and an alternative scenario of implementing RED across landscapes outside PAs. Our satellite-based spatially explicit deforestation model predicts that 1313 km2 of forest would be saved from deforestation by 2030, while forest cover present in 2006 would shrink by 22% (7913 km2) across landscapes outside PAs if RED were only to be implemented in the upland PA. Meanwhile, orangutan habitat would reduce by 16% (1137 km2), resulting in the conservative loss of 1384 orangutans, or 25% of the current total population with or without RED intervention. By contrast, an estimated 7824 km2 of forest could be saved from deforestation, with maximum benefit for orangutan conservation, if RED were to be implemented across all remaining forest landscapes outside PAs. Here, RED payments would compensate land users for their opportunity costs in not converting unprotected forests into oil palm, while the construction of new roads to service the marketing of oil palm would be halted. Our predictions suggest that Indonesia's first RED initiative in an upland PA may not significantly reduce deforestation in northern Sumatra and would have little impact on orangutan conservation because a large amount of forest inside the project area is protected de facto by being inaccessible, while lowland forests will remain exposed to the combined expansion of high-revenue plantations and road networks. In contrast, RED would be more effective in terms of its conservation impact if payments were extended to all remaining carbon-rich tropical forests, including lowland peat swamp forests, the preferred habitat for dense populations of orangutans, and if the construction of new roads was halted.

Tittinutchanon P., C. Nakharin, J. H. Clendon, and R. H. V. Corley. 2008. A review of 15 years of oil palm irrigation research in Southern Thailand. Pages 1-12.
Reference ID: 20744
Notes: #20744e
Abstract: The climate in Southern Thailand has a regular dry season, with 3 to 4 months of soil water deficit, and Univanich started commercial irrigation of oil palms in the late 1980s. Research trials have compared irrigation methods, quantities of water applied, and interactions with fertilisers, and the responses of different breeding materials.

A comparison of four irrigation methods (sprinkler, microsprayer, furrow and drip) showed no significant differences in yield responses, though there was a suggestion

that drip might be superior to the other methods, and drip was also preferred on grounds of operating costs and ease of management. Some practical aspects of drip installation are discussed in the paper. There were significant irrigation x fertiliser interactions, and with increased fertiliser inputs, the response to irrigation was more or less linear, reaching 10 t FFB/ha.yr at 6.4mm rainfall equivalent (450 litres/palm.day). The yield response to irrigation based on a calculated water deficit depended on the severity of the dry season. The response in any one year was related to the water deficit in the first quarter of the year, and also to that two years earlier; a multiple regression explained 91% of the year-to-year variation in yield response.

Results from progeny trials duplicated with and without irrigation show that some progenies appeared to be more sensitive to drought, and gave larger responses to irrigation, than others. This could give breeders the option of selecting drought tolerant material for planting in areas where irrigation is not possible, or irrigationresponsive material for sites where irrigation is intended.

Based on paper presented at the Indian National Conference on Oil Palm. February 2-4, 2008. Vijayawada, Andhra Pradesh, India.

Nelson P. N., M. Banabas, I. Goodrick, M. J. Webb, N. I. Huth, and D. O'Grady. 2015. Soil sampling in oil palm plantations: a practical design that accounts for lateral variability at the tree scale. Plant and Soil.
Reference ID: 20745
Notes: #20745e
Abstract: Aims The aim was to devise a practical soil sampling design for oil palm plantations that takes into account tree-scale variability, thus facilitating detection of trends in soil properties over time.

Methods We geometrically evaluated the ability of linear sampling transects to represent the distribution of typical management zones and radial patterns known to influence soil properties. The effect of sampling point density was tested using interpolated surfaces of soil biological, chemical and physical properties derived from values measured on a 35-point sampling grid covering the repeating tree unit in plantations with 15- 25-year old palms.

Results The ability of sampling transects to represent the proportion of the plantation in various zones improved with increasing transect length and sampling density. Increasing the number of sampling points from 10 to 50 (using an acceptably long transect with length 5.57×palm spacing) decreased the maximum deviation between the overall mean and the transect-derived mean from 15.9 to 5.6 % for the most variable parameter, respiration, and 3.2 to 0.6 % for the least variable parameter, bulk density.

Conclusions Transect sampling provides an efficient means of obtaining a composite soil sample that accounts for tree-scale variability in oil palm plantations. The method is readily adaptable for other tree crops.

Uckert G., H. Hoffmann, F. Graef, P. Grundmann, and S. Sieber. 2015. Increase without spatial extension: productivity in small-scale palm oil production in Africa-the case of Kigoma, Tanzania. Reg Environ Change.
Reference ID: 20746
Notes: #20746e
Abstract: The global demand for palm oil has increased sharply in the past and is expected to double over the coming decades. Land use changes resulting from the concomitant expansion of oil palm cultivation have caused further deforestation, which in turn has had a severely negative impact on the environment and climate. Sustainable intensification strategies are therefore required to meet the growing demand for palm oil while simultaneously improving farm household incomes, increasing food security and self-sufficiency. Palm oil production in Africa and especially in Tanzania is dominated by small-scale subsistence farming systems that are characterised by low productivity and low yields, even in regions with the most suitable cultivation conditions. By conducting stakeholder interviews, focus-group discussions and a household survey, we analysed palm oil production in the Western Tanzanian Province of Kigoma in order to gain a more complete picture of oil palm farming in smallholder systems and to better understand how smallholders evaluate certain options for the intensification of palm oil production. We identified and evaluated locally existing best practices from the farmers' perspective and identified factors which may have a positive impact on production levels. Our case study sites are characterised by large oil palm plantations that have been operating since colonial times. Also examined were farm plots with an average of 35.7 palm oil trees per acre. Palms are cultivated to produce edible vegetable oil and are used for firewood. The results indicate large differences between output levels that result from the agricultural management practice employed (e.g. using hybrid varieties, sub-optimal planting densities and low weeding or organic fertilising inputs). The processing technology used in the households examined was not conducive for changing the situation from low to high yields and productivity levels. A shift from subsistence to market-orientated production generates income opportunities for farmers and helps meet the ever-increasing demand for palm oil. Our results indicate that an improved smallscale palm oil production system, including agroforestry or mixed cropping and general intensification of plant maintenance, may increase yields without putting additional pressure on natural forestsÑa step towards ensuring palm oil is produced in a supply chain that avoids deforestation.

Gatto, M., Wollni, M., and Qaim, M. Oil palm boom and land-use dynamics in Indonesia: The role of policies and socioeconomic factors. 1-20. 2014. Goettingen, Germany, University of Goettingen.
Reference ID: 20747
Notes: #20747e
Abstract: We investigate land-use dynamics in Jambi, Sumatra, one of the hotspots of Indonesia's re-cent oil palm boom. Data from a structured village survey are used to analyze the role of socioeconom-ic and policy factors. Oil palm is partly grown on large plantations, but smallholders are also involved significantly. We find that, in spite of significant oil palm expansion, rubber remains the dominant crop. Most of the oil palm growth takes place on previous fallow and rubber land. Oil palm has not been a major driver of deforestation. Much of the forest in Jambi was cleared more than 20 years ago, and rubber was an established cash crop long before the oil palm boom started. However, oil palm growth occurs in locations with ongoing logging activities, so indirect effects on deforestation are like-ly. The government's

transmigration program of the 1980s and 1990s was instrumental for the start and spread of oil palm in Jambi. Some autochthonous villages have adopted oil palm, but adoption started later compared to migrants from Java, and it happens at a slower pace. While the transmigra-tion program benefited many of the participating families, it has contributed to the risk of unequal so-cioeconomic developments in Jambi.

Gatto M. 2015. Land-use dynamics, economic development, and institutional change in rural communities - Evidence from the Indonesian oil palm sector. University of Gottingen, Gottingen, Germany.
Reference ID: 20748
Notes: #20748e

Gibbs H. K., A. S. Ruesch, F. Achard, M. K. Clayton, P. Holmgren, N. Ramankutty, and J. A. Foley. 2010. Tropical forests were the primary sources of new agricultural land in the 1980s and 1990s. PNAS, 107:16732-16737.
Reference ID: 20749
Notes: #20749e
Abstract: Global demand for agricultural products such as food, feed, and fuel is nowamajor driver of cropland and pasture expansion acrossmuch of the developing world. Whether these new agricultural lands replace forests, degraded forests, or grasslands greatly influences the environmental consequences of expansion. Although the general pattern is known, there still is no definitive quantification of these land-cover changes. Here we analyze the rich, pan-tropical database of classified Landsat scenes created by the Food and Agricultural Organization of the United Nations to examine pathways of agricultural expansion across the major tropical forest regions in the 1980s and 1990s and use this information to highlight the future land conversions that probably will be needed to meet mounting demand for agricultural products. Across the tropics, we find that between 1980 and 2000more than 55%of newagricultural land came at the expense of intact forests, and another 28% came from disturbed forests. This study underscores the potential consequences of unabated agricultural expansion for forest conservation and carbon emissions.

Godar J., U. M. Persson, E. J. Tizado, and P. Meyfroidt. 2015. Towards more accurate and policy relevant footprint analyses: Tracing fine-scale socio-environmental impacts of production to consumption. Ecological Economics, 112:25-35.
Reference ID: 20750
Notes: #20750e
Abstract: The consumption of internationally traded goods causesmultiple socio-environmental impacts. Current methods linking production impacts to final consumption typically trace the origin of products back to the country level, lacking fine-scale spatial resolution. This hampers accurate calculation of trade and consumption footprints, masking and distorting the causal links between consumers' choices and their environmental impacts, especially in countries with large spatial variability in socio-environmental conditions and production impacts. Here we present the SEI-PCS model (Spatially Explicit Information on Production to Consumption Systems), which allows for fine-scale sub-national assessments of the origin of, and socio-environmental impacts embedded in, traded commodities. The method connects detailed production data at sub-national scales (e.g.,municipalities or provinces), information on domestic flows of goods and in international trade.

Themodel permits the downscaling of country-to-country trade analyses based on either physical allocation from bilateral trade matrices or MRIO models. The importance of producing more spatially-explicit trade analyses is illustrated by identifying the municipalities of Brazil from which different countries source the Brazilian soy they consume. Applications for improving consumption accounting and policy assessment are discussed, including quantification of externalities of consumption, consumer labeling, trade leakages, sustainable resource supply and traceability.

Gray C. L. and O. T. Lewis. 2014. Do riparian forest fragments provide ecosystem services ordisservices in surrounding oil palm plantations? Basic and Applied Ecology, 15:693-700.
Reference ID: 20751
Notes: #20751e
Abstract: Agricultural expansion across tropical regions is causing declines in biodiversity and altering ecological processes. However,in some tropical agricultural systems, conserving natural habitat can simultaneously protect threatened species and supportimportant ecosystem services. Oil palm cultivation is expanding rapidly throughout the tropics but the extent to which non-crop habitat supports biodiversity and ecosystem services in these landscapes is poorly documented. We investigated whetherriparian forest fragments (riparian reserves) provide a pest control service or increase pest activity (disservice) within oil palmdominated landscapes in Sabah, Malaysian Borneo. We assessed the activity of potential predators of pest herbivores usingplasticine caterpillar mimics and quantified herbivory rates on oil palm fronds in areas with and without riparian reserves. We alsomanipulated the shape and colour of the mimics to assess the extent to which artificial pest mimics reflect a predatory response.The presence of riparian reserves increased the attack rate on mimics by arthropods, but not by birds. Our methodologicalstudy suggested attacks on artificial pest mimics provide a better indication of predatory activity for birds than for arthropodpredators. Herbivory rates were also not significantly affected by the presence of a riparian reserve, but we found some evidencethat herbivory rates may decrease as the size of riparian reserves increases. Overall, we conclude that riparian forest fragments of 30 – 50 m width on each side of the river are unlikely to provide a pest control service. Nevertheless, our results provide evidencethat these riparian buffer strips do not increase the density of defoliating pests, which should reassure managers concerned aboutpossible negative consequences of preserving riparian buffers.

OECD. Tools for delivering on green growth. 1-25. 2011. Paris.
Reference ID: 20752
Notes: #20752e

Hansen S. B., S. I. Olsen, and Z. Ujang. 2014. Carbon balance impacts of land use changes related to the life cycle of Malaysian pam oil-derived biodiesel. Int J Life Cycle Assess, 19:558-566.
Reference ID: 20753
Notes: #20753e
Abstract: Purpose The area of oil palm plantations in Malaysia is expanding by approximately 0.14 million hectare per year, and with the increasing demand for palm oil worldwide, there is no sign of the expansions slowing down. This study aims

to identify the greenhouse gas emissions associated with land conversion to oil palm, in a life cycle perspective.

Methods LCA methodology is applied to existing land use change data. The assessment includes the issue of temporary carbon storage in the plantations. Through quantification of emissions from state forest reserve and rubber plantation conversions, the average Malaysian palm oil-related land use changes are calculated.

Results and discussion The results show that there are high emissions associated with the conversion of Malaysian state forest reserve to oil palm, whereas the conversion of rubber leaves a less significant carbon debt when indirect land use change is not included. Looking at the average Malaysian land use changes associated with oil palm shows that land use change emissions are responsible for approximately half of the total conventional biodiesel production emissions. The sensitivity analysis shows that the results could be significantly influenced by data variations in indirect land use changes, peat soils, and state forest reserve carbon stock.

Conclusions The relatively extensive conversions of the state forest reserve must be reversed and preferably with a shift toward conversion of degraded land in order for the average Malaysian land use changes to have less impact on the production life cycle of palm oil and biodiesel.

Hertel, T. W. Implications of Agricultural Productivity for Global Cropland Use and GHG Emissions: Borlaug vs. Jevons. 1-36. 2012.
Reference ID: 20754
Notes: #20754e
Abstract: This paper introduces a general framework for analyzing the impacts of regional and global technological change on long run agricultural output, prices, land rents, land use, and associated GHG emissions. In so doing, it facilitates a reconciliation of the apparently conflicting views of the impacts of agricultural productivity growth on global GHG emissions and environmental quality. As has been previously recognized, in the case of a global change in farm productivity, the critical condition for an innovation to lead to diminished land use is that the farm level demand for agricultural products is inelastic. However, in the more common case where the innovation is regional in nature, the necessary condition for a reduction in global land use and associated GHG emissions is more complex and depends on the relative yields, emissions efficiencies and supply conditions in the affected and unaffected regions. While innovations in agricultural are most common land-sparing at global scale, innovations in regions commanding a small share of global production, with relatively low yields, high land supply elasticities and low emissions efficiencies can lead to an increase in global land use change emissions. A numerical example illustrates these points and suggests that these conditions may hold for productivity shocks in Latin America and Sub-Saharan Africa. These insights are also relevant for the emerging literature on the effect of adverse climate change on global agriculture and associated emissions from land use change.

Lee J. S. H., S. Abood, J. Ghazoul, B. Barus, K. Obidzinski, and L. P. Koh. 2014. Environmental Impacts of Large-Scale Oil Palm Enterprises Exceed that of Smallholdings in Indonesia. Conservation Letters, 7: 25-33.
Reference ID: 20755
Notes: #20755e
Abstract: The expansion of large-scale oil palm plantations in Indonesia has taken a heavy toll on forests, biodiversity, and carbon stocks but little is known about the environmental impacts from the smallholder sector. Here, we compare the magnitude of forest and carbon loss attributable to smallholdings, private enterprises, and state-owned oil palm plantations in Sumatra. During 2000-2010, oil palm development accounted for the loss of 4,744 ha of mangrove, 383,518 ha of peat swamp forest, 289, 406 ha of lowland forest, and 1,000 ha of lower montane forest. Much of this deforestation was driven by private enterprises (88.3%) followed by smallholdings (10.7%) and state-owned plantations (0.9%). Oil palm-driven deforestation in Sumatra resulted in 756-1,043 Mt of total gross carbon dioxide emissions, of which ¡90% and ¡9% can be attributed to private enterprises and smallholdings, respectively. While private enterprises are responsible for the bulk of environmental impacts, the smallholder oil palm sector exhibits higher annual rates of expansion (11%) compared to private enterprises (5%). Both sectors will need careful monitoring and engagement to develop successful strategies for mitigating future environmental impacts of oil palm expansion.

Lapola D. M., R. Schaldach, J. Alcamo, A. Bondeau, J. Koch, C. Koelking, and J. A. Priess. 2010. Indirect land-use changes can overcome carbon savings from biofuels in Brazil. PNAS, 107:3388-3393.
Reference ID: 20756
Notes: #20756e
Abstract: The planned expansion of biofuel plantations in Brazil could potentially cause both direct and indirect land-use changes (e.g., biofuel plantations replace rangelands, which replace forests). In this study, weuse aspatially explicitmodel toproject land-use changescausedby that expansion in 2020, assuming that ethanol (biodiesel) production increases by 35(4)x 109 liter in the 2003-2020 period. Our simulations showthat direct land-use changeswill have a small impact on carbon emissions becausemost biofuel plantationswould replace rangeland areas. However, indirect land-use changes, especially those pushing the rangeland frontier into the Amazonian forests, could offset the carbon savings frombiofuels. Sugarcane ethanol and soybean biodiesel each contribute to nearly half of the projected indirect deforestation of 121,970 km2 by 2020, creating a carbon debt that would take about 250 years to be repaid using these biofuels instead of fossil fuels.We also tested different crops that could serve as feedstock to fulfill Brazil's biodiesel demand and found that oil palm would cause the least land-use changes and associated carbon debt. The modeled livestock density increases by 0.09 head per hectare. But a higher increase of 0.13 head per hectare in the average livestock density throughout the country could avoid the indirect land-use changes caused by biofuels (even with soybean as the biodiesel feedstock), while still fulfilling all food and bioenergy demands.We suggest that a closer collaboration or strengthened institutional link between the biofuel and cattle-ranching sectors in the coming years is crucial for effective carbon savings from biofuels in Brazil.

Laurance W. F., J. Sayer, and K. G. Cassman. 2014. Agricultural expansion and its impacts on tropical nature. Trends in Ecology & Evolution, 29:107-116.
Reference ID: 20757
Notes: #20757e
Abstract: The human population is projected to reach 11 billion this century, with the greatest increases in tropical developing nations. This growth, in concert with rising per-capita consumption, will require large increases in food and biofuel production. How will these megatrends affect tropical terrestrial and aquatic ecosystems and biodiversity? We foresee (i) major expansion and intensification of tropical agriculture, especially in Sub- Saharan Africa and South America; (ii) continuing rapid loss and alteration of tropical old-growth forests, woodlands, and semi-arid environments; (iii) a pivotal role for new roadways in determining the spatial extent of agriculture; and (iv) intensified conflicts between food production and nature conservation. Key priorities are to improve technologies and policies that promote more ecologically efficient food production while optimizing the allocation of lands to conservation and agriculture.

Li Z. and J. M. Fox. 2012. Mapping rubber tree growth in mainland Southeast Asia using time-series MODIS 250 m NDVI and statistical data. Applied Geography, 32:420-432.
Reference ID: 20758
Notes: #20758e
Abstract: Expanding global and regional markets are driving the conversion of traditional subsistence agricultural and occupied non-agricultural lands to commercial-agricultural purposes. In many parts of mainland Southeast Asia rubber plantations are expanding rapidly into areas where the crop was not historically found. Over the last several decades more than one million hectares of land have been converted to rubber trees in areas of China, Laos, Thailand, Vietnam, Cambodia and Myanmar, where rubber trees were not traditionally grown. This expansion of rubber plantations has replaced ecologically important secondary forests and traditionally managed swidden fields and influenced local energy, water and carbon fluxes. Accurate and up-to-date monitoring and mapping of rubber tree growth is critical to understanding the implications of this changing ecosystem. Discriminating rubber trees from secondgrowth forests and fallow land has proven challenging. Previous experiments using machine-learning approaches with hard classifications on remotely sensed data, when faced with the realities of a heterogeneous plant-life mixture and high intra-class variance, have tended to overestimate the areas of rubber tree growth. Our current research sought to: 1) to investigate the potential of using a Mahalanobis typicality model to deal with mixed pixels; and 2) to explore the potential for combining MOderate Resolution Imaging Spectroradiometer (MODIS) imagery with sub-national statistical data o rubber tree areas to map the distribution of rubber tree growth across this mainland Southeast Asia landscape. Our study used time-series MODIS Terra 16-day composite 250 m Normalized Difference Vegetation Index (NDVI) products (MOD13Q1) acquired between March 2009 and May 2010. We used the Mahalanobis typicality method to identify pixels where rubber tree growth had the highest probability of occurring and sub-national statistical data on rubber tree growth to quantify the number of pixels of rubber tree growth mapped per administrative unit. We used Relative Operating Characteristic (ROC) and error matrix analysis, respectively, to assess the viability of Mahalanobis typicalities and to validate classification accuracy. High ROC values, over 0.8, were achieved with the Mahalanobis typicality images of both mature and

young rubber trees. The proposed method greatly reduced the commission errors for the two types of rubber tree growth to 1.9% and 2.8%, respectively (corresponding to user's accuracies of 98.1% and 97.2%, respectively). Results indicate that integrating Mahalanobis typicalities with MODIS time-series NDVI data and sub national statistics can successfully overcome the earlier overestimation problem.

Lucey J. M., N. Tawatao, M. J. M. Senior, C. V. Khen, S. Benedick, K. C. Hamer, P. Woodcock, R. J. Newton, S. H. Bottrell, and J. K. Hill. 2014. Tropical forest fragments contribute to species richness in adjacent oil palm plantations. Biological Conservation, 169:268-276.
Reference ID: 20759
Notes: #20759e
Abstract: In Southeast Asia, large-scale conversion of rainforest to oil palm plantations is one of the major causes of biodiversity declines. Recommendations for reducing species losses and increasing the sustainability of palm oil production advocate the retention of natural forest patches within plantations, but there is little evidence for the effectiveness of this strategy. Here, we examine to what extent rainforest remnants with different characteristics contribute to biodiversity within surrounding plantations. We sampled grounddwelling ants in Sabah (Malaysian Borneo) using unbaited pit-fall traps along 1 km transects spanning forest plantation ecotones of 10 forest fragments (area 5 ha-500 ha) and two continuous forest sites which bordered plantations. Ant species richness in plantations varied according to richness in adjacent forest fragments, which increased with fragment size. A trend of declining species richness in plantations with distance from the forest ecotone was consistent with spillover of forest species into plantations adjacent to forest remnants. Ant assemblages in plantations also contained more carnivorous species adjacent to large forest fragments, suggesting large fragments may have benefits for pest control in plantations, as well as benefits for local biodiversity. Our results indicate that large forest fragments support distinctive ant assemblages and increase diversity within the planted area, but small fragments (<200 ha) contribute little to plantation diversity. Thus retaining large fragments of forest may help mitigate the loss of species within oil palm plantations.

Meijaard E. and D. Sheil. 2012. The dilemma of green business in tropical forests: how to protect what it cannot identify. Conservation Letters, 5:342-348.
Reference ID: 20760
Notes: #20760e
Abstract: Much tropical biodiversity resides in forests managed by timber, mining, and plantation companies. These companies can determine the local persistence of many species and have considerable implications for global conservation outcomes. Many companies are willing to invest in improved management as long as this does not undermine their business-indeed accessing green markets often makes commercial sense. Compliance with common standards of good commercial practice requires identification of all species of conservation significance which occur within their areas of management responsibility. But, as we demonstrate, it is impossible for companies to do this comprehensively. Such demands are often counterproductive in that they alienate those who might otherwise be willing to improve. Given the finite resources available for achieving conservation outcomes, we need to trade off data collection against other costs. To encourage adoption and implementation of conservation friendly practices requires incentives, not technical and financial obstacles. We challenge conservation biologists to reconsider the realities of good

forest management, and provide pragmatic guidance for business compatible conservation. Until we engage more effectively with commercial interests, opportunities for improved conservation outcomes will be wasted.

Meyfroidt P., K. M. Carlson, M. E. Fagan, V. H. Gutierrez-Velez, M. N. Macedo, L. M. Curran, R. S. DeFries, G. A. Dyer, H. K. Gibbs, E. F. Lambin, D. C. Morton, and V. Robiglio. 2014. Multiple pathways of commodity crop expansion in tropical forest landscapes. Environmental Research Letters, 9:1-13.
Reference ID: 20761
Notes: #20761e
Abstract: Commodity crop expansion, for both global and domestic urban markets, follows multiple land change pathways entailing direct and indirect deforestation, and results in various social and environmental impacts. Here we compare six published case studies of rapid commodity crop expansion within forested tropical regions. Across cases, between 1.7% and 89.5% of new commodity cropland was sourced from forestlands. Four main factors controlled pathways of commodity crop expansion: (i) the availability of suitable forestland, which is determined by forest area, agroecological or accessibility constraints, and land use policies, (ii) economic and technical characteristics of agricultural systems, (iii) differences in constraints and strategies between small-scale and large-scale actors, and (iv) variable costs and benefi ts of forest clearing. When remaining forests were unsuitable for agriculture and/or policies restricted forest encroachment, a larger share of commodity crop expansion occurred by conversion of existing agricultural lands, and land use displacement was smaller. Expansion strategies of large-scale actors emerge from context-specifi c balances between the search for suitable lands; transaction costs or confl icts associated with expanding into forests or other state-owned lands versus smallholder lands; net benefi ts of forest clearing; and greater access to infrastructure in alreadycleared lands. We propose fi ve hypotheses to be tested in further studies: (i) land availability mediates expansion pathways and the likelihood that land use is displaced to distant, rather than to local places; (ii) use of already-cleared lands is favored when commodity crops require access to infrastructure; (iii) in proportion to total agricultural expansion, large-scale actors generate more clearing of mature forests than smallholders; (iv) property rights and land tenure security infl uence the actors participating in commodity crop expansion, the form of land use displacement, and livelihood outcomes; (v) intensive commodity crops may fail to spare land when inducing displacement. We conclude that understanding pathways of commodity crop expansion is essential to improve land use governance.

Miettinen J., H.-J. Stibig, and F. Achard. 2014. Remote sensing of forest degradation in Southeast Asia-Aiming for a regional view through 5.30 m satellite data. Global Ecology and Conservation, 2:24-36.
Reference ID: 20762
Notes: #20762e
Abstract: In this review paper we present geographical, ecological and historical aspects of Southeast Asia from the perspective of forest degradation monitoring and critically discuss available approaches for large area forest degradation monitoring with satellite remote sensing data at high to medium spatial resolution (5.30 m). Several authors have achieved promising results in geographically limited areas within Southeast Asia using automated detection algorithms. However, the application of automated methods to large area assessments remains a major

challenge. To-date, nearly all large area assessments of forest degradation in the region have included a strong visual interpretation component. We conclude that due to the variety of forest types and forest disturbance levels, as well as the variable image acquisition conditions in Southeast Asia, it is unlikely that forest degradation monitoring can be conducted throughout the region using a single automated approach with currently available remote sensing data. The provision of regionally consistent information on forest degradation from satellite remote sensing data remains therefore challenging. However, the expected increase in observation frequency in the near future (due to Landsat 8 and Sentinel-2 satellites) may lead to the desired improvement in data availability and enable consistent and robust regional forest degradation monitoring in Southeast Asia.

Miettinen J., A. Hooijer, C. Shi, D. Tollenaar, R. Vernimmen, S. C. Liew, C. Malins, and S. E. Page. 2012. Extent of industrial plantations on Southeast Asian peatlands in 2010 with analysis of historical expansion and future projections. Global Change Biology Bioenergy, 4:908-918.
Reference ID: 20763
Notes: #20763e
Abstract: Tropical peatlands cover over 25 Mha in Southeast Asia and are estimated to contain around 70 Gt of carbon. Peat swamp forest ecosystems are an important part of the region's natural resources supporting unique flora and fauna endemic to Southeast Asia. Over recent years, industrial plantation development on peatland, especially for oil palm cultivation, has created intense debate due to its potentially adverse social and environmental effects. The lack of objective up-to-date information on the extent of industrial plantations has complicated quantification of their regional and global environmental consequences, both in terms of loss of forest and biodiversity as well as increases in carbon emissions. Based on visual interpretation of high-resolution (30 m) satellite images, we find that industrial plantations covered over 3.1 Mha (20%) of the peatlands of Peninsular Malaysia, Sumatra and Borneo in 2010, surpassing the area of Belgium and causing an annual carbon emission from peat decomposition of 230-310 Mt CO2e. The majority (62%) of the plantations were located on the island of Sumatra, and over two-thirds (69%) of all industrial plantations were developed for oil palm cultivation, with the remainder mostly being Acacia plantations for paper pulp production. Historical analysis shows strong acceleration of plantation development in recent years: 70% of all industrial plantations have been established since 2000 and only 4% of the current plantation area existed in 1990. "Business-as-usual" projections of future conversion rates, based on historical rates over the past two decades, indicate that 6-9 Mha of peatland in insular Southeast Asia may be converted to plantations by the year 2020, unless land use planning policies or markets for products change. This would increase the annual carbon emission to somewhere between 380 and 920 Mt CO2e by 2020 depending on water management practices and the extent of plantations.

Miller B., M. E. Soule, and J. Terborgh. 2014. 'New conservation' or surrender to development? Animal Conservation, 17:509-515.
Reference ID: 20764
Notes: #20764e

Miettinen J., J. Wang, A. Hooijer, and S. Liew. 2013. Peatland conversion and degradation process in insular Southeast Asia: A case study in Jambi, Indonesia. Land Degradation & Development, 24:334-341.
Reference ID: 20765
Notes: #20765e
Abstract: The ongoing conversion and degradation of insular Southeast Asian peat swamp forests causes globally important carbon emissions and leads to loss of unique biodiversity. Little quantitative information is available on the dynamics of peat swamp forest conversion. In this case study, we present a time □]series of peatland conversion and degradation in the Air Hitam Laut peatlands in Jambi Province (Sumatra, Indonesia), which included the Berbak National Park. High-resolution (10.60 m) satellite imagery was used to map land cover and degradation status for nine time slices between the 1970s and 2009. Nearly-pristine forest cover was shown to have declined in the study area from 90 to 43 per cent, inside the Berbak National Park from 95 to 73 per cent and outside the National Park from 86 to 25 per cent. Outside the protected area, 66 per cent of former nearly-pristine forests turned into degraded forests or unmanaged deforested areas. Large-scale oil palm plantations accounted for 21 per cent of the formerly nearly-pristine areas and small-holder agriculture for 8 per cent. The conversion to plantation has fast accelerated since 2002. Conversion from nearly-pristine forest to plantation typically took around 6 years, at times up to 10 years. Better understanding of conversion and degradation dynamics will allow for improved estimates of the implications of management planning decisions taken in peatland areas.

Khoo K. M. and D. Chandramohan. 2002. Malaysian palm oil industry at crossroads and its future direction. Oil Palm Industry Economic Journal, 2:10-15.
Reference ID: 20766
Notes: #20766e
Abstract: Palm oil accounts for 20% and 46% of the global oil and fats production and trade respectively. Malaysia is the world.s largest producer and exporter of palm oil with a 50% share of world palm oil production and 61% of exports. This paper assesses the growth of the Malaysian palm oil industry and the limitations of land and labour on the future growth of the industry. The industry.s competitive edge will continue to be a vital factor for its future development. Thus, in order to remain competitive, the industry needs to improve on productivity, explore opportunities to diversity the income base, widen the end-use base for palm oil, explore new marketing approaches and intensify vertical integration.

Murphy D. J. 2014. The future of oil palm as major global crop: Opportunities and challenges. Journal of Oil Palm Research, 26: 1-24.
Reference ID: 20767
Notes: #20767e
Abstract: In recent years, the oil palm sector has witnessed a period of historically high prices with buoyant global demand and high levels of production driven largely by economic development in major Asian countries such as India and China. However, the oil palm sector is also confronted by many important challenges that require attention. Such challenges include fragmentation of the industry, stagnating yields, and an image problem that is largely due to the conversion of tropical rainforest and peatlands in a few regions in South-east Asia. The biological and managerial tools to surmount these challenges already exist but need more focussed application and political support. Potentially groundbreaking biological tools include

the new molecular breeding technologies, such as those made possible by the recent publication of the oil palm genome sequence (Singh et al ., 2013a, b). Two key R&D targets for the industry are:
• higher oil yield in fruits and trees; and
• higher mesocarp oleic acid composition - preferably over 65% w/w.

The more focussed use of new and traditional technologies can also help to confront pest and disease problems, to redesign of crop architecture, and to facilitate yield and harvesting efficiency. In the medium-term future, we can look forward to a considerable geographical extension of oil palm cultivation in a broad zone across the tropics of Africa, Asia and the Americas. If these and other measures can be taken, increased palm oil output could more than meet the highest projections for future vegetable oil requirements while minimising adverse environmental consequences. Improved oil palm varieties could also considerably increase the global market share for this highly productive tropical crop at the expense of some of the less efficient temperate oilseed crops.

Nelson P. N., J. Gabriel, C. Filer, M. Banabas, J. A. Sayer, G. N. Curry, G. Koczberski, and O. Venter. 2014. Oil Palm and Deforestation in Papua New Guinea. Conservation Letters, 7:188-195.
Reference ID: 20768
Notes: #20768e
Abstract: An unprecedented increase in oil palm developments may be underway in Papua New Guinea (PNG) through controversial 'special agricultural and business leases' (SABLs) covering over two million hectares. Oil palm development can create societal benefits, but doubt has been raised about whether the SABL developers intend establishing plantations. Here, we examine the development objectives of these proposals through an assessment of their land suitability, developer experience and capacity, and sociolegal constraints. Our review reveals 36 oil palm proposals with plantings planned for 948,000 ha, a sevenfold increase over the existing planted area in PNG. Based on our criteria, however, we estimate that only five plantations covering 181,700 ha might eventuate within the foreseeable future. We conclude that most of the developers are clearing forest with no intention of cultivating oil palm, and that a large-scale land grab is therefore occurring in PNG under the guise of oil palm development.

Northrup J. M. and G. Wittemyer. 2013. Characterising the impacts of emerging energy development on wildlife, with an eye towards mitigation. Ecology Letters, 16:112-125.
Reference ID: 20769
Notes: #20769e
Abstract: Global demand for energy is projected to increase by 40% in the next 20 years, and largely will be met with alternative and unconventional sources. Development of these resources causes novel disturbances that strongly impact terrestrial ecosystems and wildlife. To effectively position ecologists to address this prevalent conservation challenge, we reviewed the literature on the ecological ramifications of this dominant driver of global land-use change, consolidated results for its mitigation and highlighted knowledge gaps. Impacts varied widely, underscoring the importance of area and species-specific studies. The most commonly reported impacts included behavioural responses and direct mortality. Examinations of mitigation were limited, but common easements included (1)

reduction of the development footprint and human activity, (2) maintenance of undeveloped, 'refuge' habitat and (3) alteration of activity during sensitive periods. Problematically, the literature was primarily retrospective, focused on few species, countries, and ecoregions, and fraught with generalisations from weak inference. We advocate future studies take a comprehensive approach incorporating a mechanistic understanding of the interplay between developmentcaused impacts and species ecology that will enable effective mitigation. Key areas for future research vital to securing a sustainable energy future in the face of development-related global change are outlined.

Othman J. 2003. Linking Agricultural Trade, Land Demand and Environmental Externalities: Case of Oil Palm in South East Asia. ASEAN Economic Bulletin, 20:244-255.
Reference ID: 20770
Notes: #20770e
Abstract: Reduction of support measures affecting soybean oil in the major soybean producing countries, as a consequence of WTO rules, coupled with rising demand for palm oil in non-traditional palm oil importing countries may lead to pronounced increases in agricultural land demand for oil palm expansion in Malaysia and Indonesia - two main palm oil producing and exporting countries. However, it is expected that the effects on agricultural land demand and consequently impact upon the environment will depend much on existing governance affecting environmental and forestry management in the two countries. Given the relatively more prevalent policy and institutional failures in Indonesia, it is anticipated that deforestation consequences and open burnings in the country will be stronger, inevitably giving rise to recurring haze externalities in the region. This study employed single and multi-country output supply exogenous policy models with explicit factor markets to examine agricultural land demand-trade linkages in the world vegetable oil markets. Shifts in export demand for palm oil and reductions of support measures affecting soybean production were simulated and effects on land use in Malaysia and Indonesia were observed under varying assumptions of environmental and forestry policy regimes in the two countries. Inferences on environmental effects are also provided.

Pacheco, P. Soybean and oil palm expansion in South America: A review of main trends and implications. 1-28. 2012. Bogor, Indonesia, CIFOR.
Reference ID: 20771
Notes: #20771e

Panichelli L., A. Dauriat, and E. Gnansounou. 2009. Life cycle assessment of soybean-based biodiesel in Argentina for export. Int J Life Cycle Assess, 14:144-159.
Reference ID: 20772
Notes: #20772e
Abstract: Regional specificities are a key factor when analyzing the environmental impact of a biofuel pathway through a life cycle assessment (LCA). Due to different energy mixes, transport distances, agricultural practices and land use changes, results can significantly vary from one country to another. The Republic of Argentina is the first exporter of soybean oil and meal and the third largest soybean producer in the world, and therefore, soybean-based biodiesel production is expected to significantly increase in the near future, mostly for exportation. Moreover,

Argentinean biodiesel producers will need to evaluate the environmental performances of their product in order to comply with sustainability criteria being developed. However, because of regional specificities, the environmental performances of this biofuel pathway can be expected to be different from those obtained for other countries and feedstocks previously studied. This work aims at analyzing the environmental impact of soybean-based biodiesel production in Argentina for export. The relevant impact categories account for the primary non-renewable energy consumption (CED), the global warming potential (GWP), the eutrophication potential (EP), the acidification potential (AP), the terrestrial ecotoxicity (TE), the aquatic ecotoxicity (AE), the human toxicity (HT) and land use competition (LU). The paper tackles the feedstock and country specificities in biodiesel production by comparing the results of soybean-based biodiesel in Argentina with other reference cases. Emphasis is put on explaining the factors that contributemost to the final results and the regional specificities that lead to different results for each biodiesel pathway.

Persson U. M. 2012. Conserve or convert? Pan-tropical modeling of REDD-bioenergy competition. Biological Conservation, 146:81-88.
Refernece ID: 20773
Notes: #20773e
Abstract: The land competition between tropical bioenergy plantations and payments for forest carbon conservation (e.g., through an international scheme for Reduced emissions from deforestation and forest degradation, REDD+) is modeled using spatially explicit data on biofuel feedstock (oil palm and sugar cane) suitability and forest biomass carbon stocks. The results show that a price on the (avoided) carbon emissions from deforestation at the same level as those from fossil fuel use makes clearing for high yielding bioenergy crops unprofitable on about 60% of the tropical evergreen forest area. For the remaining 40% deforestation remains the most profitable option. Continued profitability of forest clearing is most pronounced for oil palm bioenergy systems in Latin America and Africa, with REDD+ making deforestation for sugar cane plantations unprofitable on 97% of evergreen forest land. Results are shown to be relatively robust to assumptions regarding potential yields and to the addition of a 'biodiversity premium' on land use change emissions. While REDD+ may play an important role in stemming biodiversity loss and reducing carbon emissions from tropical deforestation in the near future, in the longer run reliance on a system that values forests solely for their carbon retention capacities poses a serious risk. It is imperative that the institutions and policies currently being established as part of REDD+ readiness activities are resilient to future changes in the incentive structures facing tropical forest countries due to, e.g., climate policy induced demand for biofuels.

Hanafi M. M. and J. Sjiaola. 1998. Cadmium and zinc in acid tropical soils: I. Soil physicochemical properties effect on their adsorption. COMMUN.SOIL SCI PLANT ANAL., 29:1919-1931.
Refernece ID: 20774
Notes: #20774e
Abstract: Interactions of heavy metals, such as cadmium (Cd) and zinc (Zn) at the soil particle surfaces play an important role in controlling their leaching losses to the underground water and their availability to plants. Adsorption isotherms for eight soils [Apas (Rhodic Hapludox), Batang (Typic Plinthudult), Jarangan (Xanthic Hapludox), Katai (Typic Hapludult), Koyah (Oxic Dystropept), Lumisir (Typic

Plinthudult), Paliu (Typic Hapludult), and Table (Typic Hapludox)] from major cocoa (Theobroma cacao L.), oil palm (Elaeis guineensis Jacq.), and rubber (Hevea brasiliensis Muell Agr.) growing areas in Tawau, Sabah, Malaysia were determined at concentrations of 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 mg Cd or Zn mL-1 in a 0.025M calcium chloride (CaCl2 -2H2 O) solution. The adsorption of Cd and Zn by the soils can successfully be explained by the Freundlich equation (r = 0.832** - 0.977**) as compared to the Langmuir equation (r = 0.130ns - 0.977**). The ability of the soils to adsorb Cd and Zn differed markedly with the highest obtained in Table soil (18.4 mg Cd kg-1 soil) for Cd and Koyah soil (29.97 mg Zn kg-1) for Zn. The important soil parameters in controlling the adsorption of both Cd and Zn in acid tropical soils were cation exchange capacity (CEC) (r = 0.888**), total aluminium (Al) content (r = 0.675**), and extractable-Al (r = 0.875**).

Hanafi M. M. 1998. Cadmium and zinc in acid tropical soils: II Influence of humic acid addition on soil properties and their adsorption. COMMUN.SOIL SCI PLANT ANAL., 29:1933-1947.
Reference ID: 20775
Notes: #20775e
Abstract: Cation exchange capacity (CEC) is one of the most important factor in influencing the adsorption of cadmiun (Cd) and zinc (Zn) in some acid tropical soils from Tawau, Sabah, Malaysia. The effect of humic acid addition on chemical properties of the soils was evaluated in an incubation study. Humic acid was added to the three soils, Katai (Typic Hapludult), Koyah (Oxic Dystropept), and Table (Typic Hapludox) at concentrations of 0, 50, 100, 150, and 350 mg carbon (C) kg-1 soil and incubated for 30 days. Changes in pH, organic-C, CEC, and adosrption of Cd and Zn were measured on these soils. With the exception of the Table soil, soil pH increased with increasing levels of humic acid addition; the same trend was also observed for organic-C and CEC of the soils. The adsorption of Cd and Zn by the soils can fully be explained by the Freundlich equation (r = 0.916** - 0.987**). The soils had a greater ability (almost 2-fold) to adsorbed Zn compared to Cd. The highest Cd and Zn adsorbed by the soil were 22.32 mg Cd kg-1 for the Table soil and 42.3 mg Zn kg-1 for the Koyah soil. Sequential extraction of soil amended with humic acid showed that Cd and Zn can be partitioned into five operational geochemical fraction viz. exchangeable, bound to carbonate, bound to iron (Fe)-manganese (Mn) oxides, bound to organic matter, and residual forms. A larger portion (50%) of Cd was in exchangeable form and the lowest (9%) in organic-bound form. Zinc in Fe-Mn oxides form accounted for about 49% of the total and 5% in organic-bound form.

Barcelos E., S. d. A. Rios, R. N. V. Cunha, R. Lopes, S. Y. Motoike, E. Babiychuk, A. Skirycz, and S. Kushnir. 2015. Oil palm natural diversity and the potential for yield improvement. Frontiers in Plant Science, 6:1-16.
Reference ID: 20776
Notes: #20776e
Abstract: African oil palm has the highest productivity amongst cultivated oleaginous crops. Species can constitute a single crop capable to fulfill the growing global demand for vegetable oils, which is estimated to reach 240 million tons by 2050. Two types of vegetable oil are extracted from the palm fruit on commercial scale. The crude palm oil and kernel palm oil have different fatty acid profiles, which increases versatility of the crop in industrial applications. Plantations of the current varieties have economic life-span around 25-30 years and produce fruits around the year.

Thus, predictable annual palm oil supply enables marketing plans and adjustments in line with the economic forecasts. Oil palm cultivation is one of the most profitable land uses in the humid tropics. Oil palm fruits are the richest plant source of pro-vitamin A and vitamin E. Hence, crop both alleviates poverty, and could provide a simple practical solution to eliminate global pro-vitamin A deficiency. Oil palm is a perennial, evergreen tree adapted to cultivation in biodiversity rich equatorial land areas. The growing demand for the palm oil threatens the future of the rain forests and has a large negative impact on biodiversity. Plant science faces three major challenges to make oil palm the key element of building the future sustainable world. The global average yield of 3.5 tons of oil per hectare (t) should be raised to the full yield potential estimated at 11-18t. The tree architecture must be changed to lower labor intensity and improve mechanization of the harvest. Oil composition should be tailored to the evolving needs of the food, oleochemical and fuel industries. The release of the oil palm reference genome sequence in 2013 was the key step toward this goal. The molecular bases of agronomically important traits can be and are beginning to be understood at the single base pair resolution, enabling gene-centered breeding and engineering of this remarkable crop.

Yui S. and S. Yeh. 2013. Land use change emissions from oil palm expansion in Para, Brazil depend on proper policy enforcement on deforested lands. Environ.Res.Lett., 8:1-9.
Reference ID: 20777
Notes: #20777e
Abstract: Brazil aims to increase palm oil production to meet the growing national and global demand for edible oil and biodiesel while preserving environmentally and culturally significant areas. As land use change (LUC) is the result of complex interactions between socio-economic and biophysical drivers operating at multiple temporal and spatial scales, the type and location of LUC depend on drivers such as neighboring land use, conversion elasticity, access to infrastructure, distance to markets, and land suitability. The purpose of this study is to develop scenarios to measure the impact of land conversion under three different enforcement scenarios (none, some, and strict enforcement). We found that converting 22.5 million hectares of land can produce approximately 29 billion gallons (110 billion liters) of biodiesel a year. Of that, 22-71% of the area can come from forest land, conservation units, wetland and indigenous areas, emitting 14-84 gCO2 e MJ..1 . This direct land use emission alone can be higher than the carbon intensity of diesel that it intends to displace for lowering greenhouse gas emissions. This letter focuses narrowly on GHG emissions and does not address socio-economicÐecological prospects for these degraded lands for palm oil or for other purposes. Future studies should carefully evaluate these tradeoffs.

UNEP. Assessing global land use: Balancing consumption with sustainable supply. 1-131. 2014. United Nations Environment Programme.
Reference ID: 20778
Notes: #20778e

Tata H. L., M. van Noordwijk, D. Ruysschaert, R. Mulia, S. Rahayu, E. Mulyoutami, A. Widayati, A. Ekadinata, R. Zen, A. Darsoyo, R. Oktaviani, and S. Dewi. 2014. Will funding to Reduce Emissions from Deforestation and (forest) Degradation (REDD+) stop conversion of peat swamps to oil palm in orangutan habitat in Tripa in Aceh, Indonesia? Mitig Adapt Strateg Glob Change, 19:693-713.
Reference ID: 20779
Notes: #20779e
Abstract: Tripa is the last remaining peat-swamp forest that harbours a potentially viable Sumatran orangutan (Pongo abelii) sub-population in a formally but not effectively protected area. It appears to be a simple showcase where current efforts to financially support reducing emissions from deforestation and forest degradation (REDD+) converge with biodiversity and social co-benefits. In practice, however, situation is more complex. REDD+ efforts interact with global palm oil trade and regulatory approaches (the moratorium) to achieve national goals for emissions reduction under umbrella of nationally appropriate mitigation actions (NAMA). To contextualize this debate, we assessed (i) land-use history and formal basis of palm-oil companies' rights; (ii) carbon (C) stocks, historical emission levels and potential emissions that can be avoided; (iii) economic benefits of land-use options and opportunity costs of avoiding emissions; (iv) biodiversity and environmental services; and (v) alternative options for "high C stock development" and employment generation. Natural forest cover declined (54 % in 1995, 18 % in 2009) while oil palm increased 4-39 %. Aboveground C stocks decreased from 148 Mg ha-1 in 1990 to 61 Mg ha-1 in 2009, leading to average annual emissions of 14.5 Mg (carbon dioxide) CO2e ha-1 year-1.While 41 % of these emissions yield less than American Dollar (USD) 5 of current economic benefits per Mg CO2e emitted and might be compensated by REDD+, nearly all new emissions derive from a breach of existing laws, regulations and voluntary palm-oil standards. Substantial investment in alternative employment is needed, rather than carbon payments per se, to support livelihoods in a low carbon emissions economy.

Stibig H.-J., F. Achard, S. Carboni, R. Rasi, and J. Miettinen. 2014. Change in tropical forest cover of Southeast Asia from 1990 to 2010. Biogeosciences, 11:247-258.
Reference ID: 20780
Notes: #20780e
Abstract: The study assesses the extent and trends of forest cover in Southeast Asia for the periods 1990-2000 and 2000-2010 and provides an overview on the main causes of forest cover change. A systematic sample of 418 sites (10 km×10 km size) located at the one-degree geographical confluence points and covered with satellite imagery of 30m resolution is used for the assessment. Techniques of image segmentation and automated classification are combined with visual satellite image interpretation and quality control, involving forestry experts from Southeast Asian countries. The accuracy of our results is assessed through an independent consistency assessment, performed from a subsample of 1572 mapping units and resulting in an overall agreement of > 85% for the general differentiation of forest cover versus non-forest cover. The total forest cover of Southeast Asia is estimated at 268Mha in 1990, dropping to 236 Mha in 2010, with annual change rates of 1.75 Mha (0.67 %) and 1.45 Mha (0.59 %) for the periods 1990-2000 and 2000- 2010, respectively. The vast majority of forest cover loss (2 / 3 for 2000-2010) occurred in insular Southeast Asia. Complementing our quantitative results by indicative information on patterns and on processes of forest change, obtained from the

screening of satellite imagery and through expert consultation, respectively, confirms the conversion of forest to cash crops plantations (including oil palm) as the main cause of forest loss in Southeast Asia. Logging and the replacement of natural forests by forest plantations are two further important change processes in the region.

Stevenson, J., Byerlee, D., Villoria, N., Kelley, T., and Maredia, M. Agricultural technology, global land use and deforestation: A review. 1-37. 2011.
Reference ID: 20781
Notes: #20781e
Abstract: We review the complex relationship between the adoption of new agricultural technologies and land use change, explaining the multiple causal pathways of impact between adoption of yield-increasing technologies (such as an improved variety), land use change in general, and deforestation in particular. We present new estimates of the impact of crop germplasm improvement in the major mandate crops of the CGIAR between 1965 and 2004 on global land-use change, using the Global Trade Analysis Project Agro-ecological Zone model (GTAP-AEZ): a multi-commodity, multi-regional computable general equilibrium model linked to a global spatially-explicit database on land use. We find support for Norman Borlaug's hypothesis that increases in cereal yields as a result of widespread adoption of Green Revolution technology have saved natural ecosystems from being converted to agriculture, although our results suggest that this effect is of a much smaller magnitude than Borlaug argued. We find that the total agricultural area in 2004 would have been between 17.9 and 26.7 million hectares larger in a counterfactual world which had not benefited from crop germplasm improvement since 1965. Of these counterfactual hectares, 12.0 to 17.7 million hectares would have been in developing countries. This estimate is similar to that of the paper by Evenson and Rosegrant from 2003 (24 to 32 million ha globally) using the IMPACT model. The results of additional simulations in GTAP on productivity shocks to soybean in Brazil and oil palm in Indonesia and Malaysia are also reported to illustrate the similarities and differences between productivity improvement in cereals and oilseeds. We conclude by suggesting how the CGIAR can best ensure it maximizes its potential positive impact on the issue of global land-use change.

Sodhi N. S., L. P. Koh, R. Clements, T. C. Wanger, J. K. Hill, K. C. Hamer, Y. Clough, T. Tscharntke, M. R. C. Posa, and T. M. Lee. 2010. Conserving Southeast Asian forest biodiversity in human-modified landscapes. Biological Conservation, 143:2375-2384.
Reference ID: 20782
Notes: #20782e
Abstract: Southeast Asia experiences one of the highest rates of deforestation in the tropics due to agricultural expansion, logging, habitat fragmentation and urbanization, which are expected to result in species declines and extinctions. In particular, growing global demands for food, biofuel and other commodities are driving the rapid expansion of oil palm and paper-and-pulp industries at the expense of lowland dipterocarp forests, further jeopardizing Southeast Asian forest biotas. We synthesize recent findings on the effects of land-use changes on plants, invertebrates, vertebrates and ecosystem functioning/services in Southeast Asia. We find that species richness and abundance/density of forest-dependent taxa generally declined in disturbed compared to mature forests. Species with restricted ranges and those with habitat and foraging specialization were particularly vulnerable. Forest

loss also disrupted vital ecosystem services(e.g. crop pollination). Long-term studies are needed to understand biotic sustainability in regenerating and degraded forests, particularly in the context of the synergistic or additive effects of multiple agents of biodiversity loss (e.g. invasive species and climate change). The preservation of large tracts of mature forests should remain the principal conservation strategy in the tropics. In addition, reforestation and reintroductions of native species, as well as improved connectivity among forest patches could enhance the conservation value of forest remnants in human-dominated landscapes.

Sheil, D., Casson, A., Meijaard, E., van Noordwijk, M., Gaskell, J., Sunderland-Groves, J., Wertz, K., and Kanninen, M. The impacts and opportunities of oil palm in Southeast Asia: What do we know and what do we need to know? 1-67. 2009. Bogor, Indonesia, CIFOR.
Reference ID: 20783
Notes: #20783e Occasional paper no. 51
Abstract: The ongoing expansion of oil palm plantations in the humid tropics, especially in Southeast Asia, is generating considerable concern and debate. Amid industry and environmental campaigners' claims, it can be hard to perceive reality. Is oil palm a valuable route to sustainable development or a costly road to environmental ruin? Inevitably, any answer depends on many choices. But do decision makers have the information they require to avoid pitfalls and make the best decisions?

This review examines what we know and what we don't know about oil palm developments. Our sources include academic publications and 'grey' literature, along with expert consultations. Some facts are indisputable: among these are that oil palm is highly productive and commercially profitable at large scales, and that palm oil demand is rising.

Implementing oil palm developments involves many tradeoffs. Oil palm's considerable profitability offers wealth and development where wealth and development are neededÑbut also threatens traditional livelihoods. It offers a route out of poverty, while also making people vulnerable to exploitation, misinformation and market instabilities. It threatens rich biological diversity-while also offering the finance needed to protect forest. It offers a renewable source of fuel, but also threatens to increase global carbon emissions.

We remain uncertain of the full implications of current choices. How can local, regional and international benefits be increased while costs are minimised? While much important information is available, it is often open to question or hard to generalise. We conclude this review with a list of pressing questions requiring further investigation. Credible, unbiased research on these issues will move the discussion and practice forward.

van der Werf H. M. G., T. Garnett, M. S. Corson, K. Hayashi, D. Huisingh, and C. Cederberg. 2014. Towards eco-efficient agriculture and food systems: theory, praxis and future challenges. Journal of Cleaner Production, 73:1-9.
Reference ID: 20784
Notes: #20784e
Abstract: This paper introduces the Special Volume (SV) dedicated to the 2012 Life Cycle Assessment (LCA) Food Conference. During recent years, these conferences

have seen a rapid increase in the number of participants, reflecting the development of an interdisciplinary research and development community at the intersection between the agronomic, food/nutrition science and environmental system analysis disciplines. This introductory paper summarises the key issues addressed in the individual papers of this SV, which present a balance between methodological and applied studies. The application of LCA to agro-food systems exemplifies a dynamic and productive interaction between scientific disciplines that previously led separate lives. As a result, LCA in the agro-food sector leads LCA methodological developments on topics such as theattributional versus consequential debate, land use changes, impacts on biodiversity, biotic resource depletion, water use, soil quality, and modelling of direct emissions of crop and animal production systems. Future challenges for the LCA Food research and development domain concern the following issues: functional unit and multi-functionality, emission models, land occupation and transformation, LCA for low-income countries, resilience of agro-food systems and presentation and transparency of results.

Koh L. P. and J. Ghazoul. 2010. Spatially explicit scenario analysis for reconciling agricultural expansion, forest protection, and carbon conservation in Indonesia. PNAS, 107:11140-11144.
Reference ID: 20785
Notes: #20785e
Abstract: Palm oil is the world's most important vegetable oil in terms of production quantity. Indonesia, the world's largest palm-oil producer, plans to double its production by 2020, with unclear implications for the other national priorities of food (rice) production, forest and biodiversity protection, and carbon conservation. We modeled the outcomes of alternative development scenarios and show that every single-priority scenario had substantial tradeoffs associated with other priorities. The exception was a hybrid approach wherein expansion targeted degraded and agricultural lands that are most productive for oil palm, least suitable for food cultivation, and contain the lowest carbon stocks. This approach avoided any loss in forest or biodiversity and substantially ameliorated the impacts of oil-palm expansion on carbon stocks (limiting net loss to 191.6 million tons) and annual food production capacity (loss of 1.9 million tons). Our results suggest that the environmental and land-use tradeoffs associated with oil-palm expansion can be largely avoided through the implementation of a properly planned and spatially explicit development strategy.

Pfund J.-L., J. D. Watts, M. Boissiere, A. Boucard, R. M. Bullock, A. Ekadinata, S. Dewi, L. Feintrenie, P. Levang, S. Rantala, D. Sheil, T. C. H. Sunderland, and Z. L. Urech. 2011. Understanding and Integrating Local Perceptions of Trees and Forests into Incentives for Sustainable Landscape Management. Environmental Management, 48:334-349.
Refernece ID: 20786
Notes: #20786e
Abstract: We examine five forested landscapes in Africa (Cameroon, Madagascar, and Tanzania) and Asia (Indonesia and Laos) at different stages of landscape change. In all five areas, forest cover (outside of protected areas) continues to decrease despite local people's recognition of the importance of forest products and services. After forest conversion, agroforestry systems and fallows provide multiple functions and valued products, and retain significant biodiversity. But there are indications that such land use is transitory, with gradual simplification and loss of

complex agroforests and fallows as land use becomes increasingly individualistic and profit driven. In Indonesia and Tanzania, farmers favor monocultures (rubber and oil palm, and sugarcane, respectively) for their high financial returns, with these systems replacing existing complex agroforests. In the study sites in Madagascar and Laos, investments in agroforests and new crops remain rare, despite government attempts to eradicate swidden systems and their multifunctional fallows. We discuss approaches to assessing local values related to landscape cover and associated goods and services. We highlight discrepancies between individual and collective responses in characterizing land use tendencies, and discuss the effects of accessibility on land management. We conclude that a combination of social, economic, and spatially explicit assessment methods is necessary to inform land use planning. Furthermore, any efforts to modify current trends will require clear incentives, such as through carbon finance. We speculate on the nature of such incentive schemes and the possibility of rewarding the provision of ecosystem services at a landscape scale and in a socially equitable manner.

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Oberthür, T., Janetski, K., and Janestski, N. Nutrient stewardship for improved cocoa production & quality. 2015.
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Notes: H 8.1.4.1 20793e

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Hartemink A. E. and R. M. Bourke. 2000. Nutrient deficiencies of agricultural crops in Papua New Guinea. Outlook on Agriculture, 29:97-108.
Reference ID: 20810
Notes: #20810e

Abstract: In Papua New Guinea the population is growing faster than the area under cultivation. As a result, land use is being intensified and soil nutrient depletion may occur, resulting in nutrient deficiencies of agricultural crops. This paper reviews nutrient deficiencies in the agricultural crops of Papua New Guinea using the literature on agronomic trials, expert knowledge and Geographical Information System (GIS) soil fertility databases. One of the aims of this overview is to discuss the spatial distribution of common nutrient deficiencies, which will facilitate the formulation of future strategies on integrated nutrient management research. Nutrient deficiencies have been investigated systematically since the mid-1950s. Research has mainly focused on export tree crops, and relatively little information is available on food crops. Literature analysis and expert knowledge showed consistent trends with deficiencies of B and P in large parts of the highlands. GIS soil fertility databases confirm these observations. The authors' method has been shown to be useful in delineating areas in which nutrient deficiencies occur, and these findings could be used for the planning of nutrient management research and extension activities.

Fontes A. G., A. C. Gama-Rodrigues, E. F. Gama-Rodrigues, M. V. S. Sales, M. G. Costa, and R. C. R. Machado. 2014. Nutrient stocks in litterfall and litter in cocoa agroforests in Brazil. Plant and Soil, 383:313-335.
Reference ID: 20811
Notes: #20811e
Abstract: Aim To compare the internal balances of nutrients and the rates of nutrient cycling across nine cocoa agroforestry systems consisting of various combination of soil types (Latosols and Cambisols), production systems (cabruca and Erythrina glauca-shade) and fertilization regimes in southern Bahia, Brazil.

Methods We measured nutrient stocks in litter fall production, in the accumulated litter and fruits. The internal nutrient balance for various simulations was obtained by the following expressions: (1) Balance 1 = litter - fruit (seeds and husks) and (2) Balance 2 = (litter + husks) - seeds. Annual litter decomposition coefficients (k) and subsequent potential of nutrient release were also investigated. The data were analyzed by principal components analysis and by Pearson correlations.

Results There was a high degree of dissimilarity among the cocoa agrosystems in relation to the nutrient cycling and the internal nutrient balance. The mean annual litterfall production ranged from 4.6 to 8.5 Mg/ha, and the amount of accumulated litter ranged from 7.7 to 16.8 Mg/ha. The results showed significant differences in quality among litter from cocoa agroforests; the decomposition coefficient of litter and the subsequent nutrient release were regulated by the litter quality. In general, the cocoa-erythrina system presented a higher capacity to recycle nutrients compared to the cocoa-cabruca system, with the cocoa-erythrina system having the largest transfer rate of nutrients through litterfall, high values for the decomposition coefficient of litter and the lowest values for the Mean Residence Time of nutrients. Cocoa tree leaves functioned as a sink of nutrients, while shade tree leaves functioned predominantly as a source. The nutritional reserves of litter + cocoa fruit husks, with respect only to the nutrients exported in the seeds, the balance was positive for all nutrients (N, P, K, Ca and Mg) in all agroforests, which emphasizes the potential productive capacity of these agroforests to sustain the estimated production in different harvest cycles.

Conclusions The internal balance of nutrients reflects an agroforests's productive capacity, which accumulated litter and cocoa fruit husks may be important nutrient sources that could enable the development of fertilizer recommendation systems aimed at increasing the efficiency of fertilizer use and at maintaining soil fertility in cocoa agroforests. Therefore, further research is needed to develop nutritional balance systems integrating litter + fruits stock and other nutrient pathways (e.g., soil quality, biological N fixation, leaching), which were not measured, for making recommendations regarding liming and fertilizers that are suitable for highly complex biological agrosystems, such as cocoa agroforests that have low levels of elements exported during seed production.

Puentes-Paramo Y. J., J. C. Menjiwar-Flores, A. Gomez-Carabali, and F. Aranzazu-Hernandez. 2014. Absorption and distribution of nutrients in cocoa and its effect on yield. Acta Agronomica, 63:145-152.
Reference ID: 20812
Notes: #20812e
Abstract: The study was conducted at the Experimental Center of the National Federation of Cocoa from Colombia, to determine the absorption and distribution of NPK in the leaves, husk and almond in clones of cacao (Theobroma cacao L.), CCN-51 and ICS-95 (self-compatible) and TSH-565, ICS-39 (self-incompatible), and its influence on performance. The experimental design was randomized complete block with five treatments and four replicates and two treatments were: control (TR, concentration of nutrient (NPK) soil natural 49-23,5-146.5 kg / ha), and increases in the concentration of NPK (kg / ha): 25%(T1), 50%(T2),75%(T3) and 100%(T4). The analysis of variance showed differences ($p < 0.01$) in the concentration of nutrients in leaves, husk and almond. Thus, higher concentrations of N and P were in almonds and K in husk, the order of preference in leaf and almond was: NKP and husk was KNP. The highest yield was obtained at T2, showing superiority for self-compatible clones, as well as the increased extraction of NPK per 1000 kg of dry grain. All clones stored the same sequence of nutrient concentration in leaf, husk and almond, however, it is evident the difference in the absorption and distribution of nutrients, and in performance between clones, which is relevant to the efficient crop nutrition management.

De Santana Dantas P. A., J. O. de Souza Junior, F. P. Gomes, and D. O. Ribeiro. 2012. Non Destructive Estimation Of Foliar Nitrogen In Cacao Tree Using Chlorophyll Meter. Rev.Bras.Frutic., Jaboticabal - SP, 34:669-677.
Reference ID: 20813
Notes: #20813e
Abstract: The replacement of the traditional method for evaluating the nitrogen (N) in the plant by the use of portable chlorophyll meter SPAD is promising because it is a portable device that provides a nondestructive, instant and low cost index. This study aimed to determine the ability of this device in estimating leaf N content of cocoa. The area covered by this study involves the wet and humid climate zones of the sub humid cocoa region of Bahia. Were selected ten farms, in each area, with crops in agroforestry system and that the area had renewed by grafting of basal shoot with clones tolerant to witches' broom. In each farm, four plants over the age of four years were selected in different topographic and soil conditions. It was collected eight healthy leaves per plant and in each, was made six SPAD readings of the index. Furthermore, were determined the N content, N content, leaf area (LA) and specific leaf mass (SLM). The SPAD index was significantly positively correlated with leaf N

content (r = 0.74), with AF (r = 0.62) and negatively with the MFE (r=-0.57). There was no correlation between N content and SPAD index. There was no correlation between N content and SPAD index. The simple linear regression model to predict the N content from SPAD index, without distinction of environments was more appropriate.

Acquaye D. K. 1967. Foliar Analysis As A Diagnostic Technique In Cocoa Nutrition .II. Errors During Preparation Phase Prior To Analysis Of Leaf Samples. Journal of the Science of Food and Agriculture, 18:24-28.
Reference ID: 20814
Notes: #20814e
Abstract: Errors arising from the preparative phase of storing the fresh harvested cocoa leaves during transit to the laboratory, washing, drying, grinding and storage of the ground material before analysis have been studied. A procedure aimed at reducing such errors is recommended.

Acquaye D. K. 1964. Foliar Analysis As A Diagnostic Technique In Cocoa Nutrition .I. Sampling Procedure And Analytical Methods. Journal of the Science of Food and Agriculture, 15:855-863.
Reference ID: 20815
Notes: #20815e
Abstract: The analytical methods used in foliar diagnosis at the Cocoa Research Institute, Tafo, are described : and their accuracy and precision tested by statistical analysis. The variables which might influence the harvesting of a representative leaf sample were studied. The age, size and position of leaf with respect to light and time of day of sampling affected nutrient concentrations of N, P, K, Mg and Ca in the leaves. Sampling of alternate trees of a plot of IOO trees (planted at 8 ft. x 8 f t) indicated that on the average about 50% and 14% of the tree population should be sampled to show a significant difference of 100/0 and 20% respectively at P = 0.05.

A sampling procedure is recommended.

Wezel A.and J.-C. Jauneau. 2011. Agroecology - Interpretations, approaches and their links to nature conservation, rural development and ecotourism. Pages 1-25 in WB Campbell and SL Ortiz, editors. Integrating agriculture, conservation and ecotourism: Examples from the field. Springer Science+Business Media B.V.
Reference ID: 20816
Notes: S 2 #20816 < #20789
Abstract: Different interpretations and definitions of agroecology are currently used world-wide. They vary from agroecology as a practice, agroecology as a movement, and varying approaches to agroecology as a scientific discipline, which are the plot/field, the agroecosystem, and the food system approach. The evolution of the interpretations and definitions are often closely linked to differences in the historical development of agroecology in different countries and regions of the world. More and more topics have become related to agroecology in recent years. In the second part of this review, we analyse and discuss the integration and linking of rural development, nature conservation and ecotourism, both within and to the framework of agroecology.

Weindorf D. C., J. P. Muir, and C. Landeros-Sanchez. 2011. Organic compost and manufactured fertilizers: Economics and ecology. Pages 27-53 in WB Campbell and SL Ortiz, editors. Integrating agriculture, conservation and ecotourism: Examples from the field. Springer Science+Business Media B.V.
Reference ID: 20817
Notes: S 2 #20817 < #20789
Abstract: Compost is a highly diverse group of organic soil amendments which provides substantial nutritive fertility to soils. The benefits of compost addition to soils are vast and have been well documented by a growing body of research. Composts are manufactured in a variety of methods and scales from simple localized plots to large scale commercial operations. This review examines the role of organic matter in soils, the process of composting, and the physical, chemical, and biological properties of compost. The global use of compost and its agro-ecological implications is explored. The review concludes with appropriate uses of compost, its comparison to traditional commercial fertilizer, as well as some limitations for its proper use.

Johnson R. J., J. A. Jedlicka, J. E. Quinn, and J. R. Brandle. 2011. Global perspectives on birds in agricultural landscapes. Pages 55-140 in WB Campbell and SL Ortiz, editors. Integrating agriculture, conservation and ecotourism: Examples from the field. Springer Science+Business Media B.V.
Reference ID: 20818
Notes: S 2 #20818 < #20789
Abstract: Earth is home for about 10,000 bird species. They inhabit all continents and interface with agroecosystems worldwide. Bird migrations across continents and nations make birds a truly global phenomenon of broad but complex conservation appeal. Global agricultural expansion during the past 200 years and intensification in the last 50 have been key drivers in global habitat loss and in declines of about 60% of the birds listed on the IUCN red list. Agricultural intensification is a continued concern as is expansion in tropical areas such as Latin America. Maintaining field-edge and set-aside habitats and using lower-intensity practices in production areas are important options for sustaining bird populations globally. Many key threats to birds in agroecosystems are global but specific impacts and management options may differ among geographical areas. Global climate change creates uncertainties for agriculture and birds, including impacts on bird migration and nesting, and concerns about synchrony between birds, habitats, and food resources. Climate change adds to other existing challenges of habitat loss and fragmentation, urbanization, migration barriers, and uncertain food resources. The push for biofuels has resulted in production intensification and habitat losses, especially removal of set-aside lands. Wildlife-friendly farming approaches can facilitate bird movement in fragmented agroecosystems and can provide important habitat for agricultural species and migratory birds. Wildlife-friendly and land sparing approaches are currently being debated toward the goal of sustaining biodiversity and food production. Global influences from social and political systems affect agroecosystems, people, and birds.

Ecotourism may hold potential to benefit local economies, people, and biodiversity if proper and persistent attention is given to ensure these outcomes. Producing food and fiber while, at the same time, sustaining biodiversity and ecosystem services is a challenge for interdisciplinary research in collaboration with working farms and farmers. Research and decision-support tools are needed to facilitate development

of policies and infrastructures to support sustainable agriculture and to facilitate conservation of biodiversity in agroecosystems. A conservation vision for the future is needed that embraces the realities of both natural resource limits and human desires for improved quality of life. The positive relationships between people, birds, and sustainable farms may be a key starting point to develop such a vision.

Jha S., C. M. Bacon, S. M. Philpott et al. 2011. A review of ecosystem services, farmer livelihoods and value chains in shade coffee agroecosystems. Pages 141-208 in WB Campbell and SL Ortiz, editors. Integrating agriculture, conservation and ecotourism: Examples from the field. Springer Science+Business Media B.V.
Reference ID: 20819
Notes: S 2 #20819 < #20789
Abstract: Cultivation, processing, and consumption of coffee are dynamic processes that connect coffee farmers and agro-ecosystems with coffee drinkers spanning the globe. As a cash crop, coffee cultivation gained popularity in the Old and then the New world, and flourished under colonial regimes of the nineteenth and twentieth century. Coffee production patterns and management styles have changed drastically in the past two centuries and continue to shift, with the greatest recent expansions in East Asia. Traditionally, coffee is cultivated under a canopy of shade trees, a practice that ensures the longevity of the farm, supports biodiversity, and provides communities with a broad array of ecosystem services. However, many modern management schemes abandon shade practices. On the other hand, specialty coffee markets, like certified organic, certified shade (Bird Friendly), Fair Trade, and other certified coffees have gained recent popularity, though they still represent a small fraction of the global coffee economy. The global coffee economy is comprised of a wide array of coffee value chains that connect farmers with consumers, and thus impact farmer livelihoods at multiple spatial scales. Key players in the coffee value chain include local cooperatives, national government agencies, and global certification agencies. Similarly, ecosystem services provided by shade coffee occur at local, regional, and global scales, including pollination, erosion-control, and carbon sequestration, respectively. While the ecological and socio-economic costs and benefits associated with shade coffee are clear, this review reveals that there are many challenges to bridging sustainable coffee management with livelihood security. Furthermore, in this review we identify existing gaps in the literature and a number of promising research directions concerning the ecological and socio-economic impacts of coffee production.

Idol T., J. Haggar, and L. Cox. 2011. Ecosystem services from smallholder forestry and agroforestry in the tropics. Pages 209-270 in WB Campbell and SL Ortiz, editors. Integrating agriculture, conservation and ecotourism: Examples from the field. Springer Science+Business Media B.V.
Reference ID: 20820
Notes: S 2 #20820 < #20789
Abstract: Smallholder forestry and agroforestry systems in the tropics provide essential products and services for millions of producers, their surrounding communities, national and international consumers, and global society. The diversity of products provided by these systems meet the needs of smallholder producers for fuelwood, food, animal fodder, and other household and farm needs; they provide additional income to supplement major commodity crops; and they offer flexibility in production and income to buffer against falling commodity prices, crop failure, or other sources of financial or economic difficulty. The sustainability of these systems

is increasingly dependent upon sources of income beyond the sale of conventional products, such as price premiums from sustainability certification and agro- and ecotourism. Payments for ecosystem services (PES) programs have been developed at multiple levels to provide incentives for smallholders to conserve and enhance tree cover and management practices to provide ecosystem services such as watershed protection and carbon sequestration. Ecotourism provides an enterprise-based strategy to engage producers in conservation and enhancement of these services. This review evaluates the ability of smallholder systems to support the provision of ecosystem services (ES) and the capacity of smallholders to participate in support programs and take advantage of other emerging opportunities to support smallholder enterprises.

Findings suggest that there are a variety of smallholder forestry and agroforestry systems that support the provision of ES as well as the sustainability of smallholder enterprises, but only a few common systems have been well-studied. By themselves, smallholder systems can support ES at the local scale, such as protection against runoff and erosion and retention and cycling of nutrients. The mosaic of smallholder systems within a watershed or a landscape can support plant and animal biodiversity, water quality, and carbon sequestration - both avoiding losses and providing for net gains. However, the limited size and great diversity of smallholder systems impose significant constraints on provisioning of ES at larger scales and thus the ability of individual producers to obtain sustainability certification or qualify for PES programs. Ecotourism offers an alternative, enterprise-based approach for compensating smallholders for ecosystem services. As with PES programs, individual smallholders have limited capacity to participate in and influence the structure and contract terms of ecotourism enterprises. Promoting community-based resource management as a part of project or enterprise development activities is recommended to coordinate the provision of ecosystem services across multiple landowners, share resources and expertise, distribute costs and returns equitably, and strengthen the social capital necessary to carry out successful enterprises. This requires participatory approaches to train producers in adaptive management and help them articulate their own needs and the types of systems that can meet household needs and support ES. Such an approach is key to slowing the tide of rural out-migration and farm consolidation that are the real threats to the sustainability of smallholder systems and the communities they support.

Weizeneggar S.and A. Wezel. 2011. Sustainable development of an agricultural region - The case of the Allgau, Southern Germany. Pages 271-298 in WB Campbell and SL Ortiz, editors. Integrating agriculture, conservation and ecotourism: Examples from the field. Springer Science+Business Media B.V.
Reference ID: 20821
Notes: S 2 #20821 < #20789
Abstract: Since the United Nations Conference on Environment and Development in 1992 in Rio de Janeiro, Brazil, much has been written about sustainable development. Nevertheless, information about sustainable development linked explicitly to a particular region is still relatively rare. In this review, we analyse and evaluate the sustainable development of the Allgäu, a rural agricultural region in southern Germany which has high touristic potential. The Allgäu is a typical rural region which had to experience many challenges, and undergo many changes and adaptations during its history, even when living conditions were not easy until the midst of the twentieth century.

From our evaluation we conclude that there is a relatively positive economic, social and ecological development towards sustainability. There exists a good economic and income situation for most people, good ecological conditions with relatively rich biodiversity, a relatively well-established social structure, as well as a certain identity with the region and relatively low social discrepancy. Nevertheless, different actual and future threats exist such as potential negative impacts related to increased development of the tourism sector, intensification or abandonment of agriculture in certain areas, or loss of traditions and customs.

Anon. 1980. Proceeding loka karya karet. Pages 1-374 Rubber Reseach Centre Tamjung Morawa, Medan, Indonesia.
Reference ID: 20822
Notes: S8.1.2 #20822

Wilson, T. B. The West Johore coconut production survey. 104, 1-47. 1958. Kuala Lumpur, Malaysia, Department of Agriculture.
Reference ID: 20823
Notes: S8.1.3 #20823

Anon. 1980. Proceedings of National Cocoa Conference. Pages 1-238 National Cocoa Conference, Medan, Indonesia.
Reference ID: 20824
Notes: S8.1.4 #20824

Zaini, Z., Adie, M. M., Djarkasji., and Wilis, J. Pengelolaan hara spesifik lokasi tanaman jagung. 1-38. 2008.
Reference ID: 20825
Notes: S8.2.2 #20825

Murphy D. J. 2014. From bioinformatics to Brazil: The future of oil palm as a major 21st century global crop. Malaysian Oil Science and Technology, 23:1-12.
Reference ID: 20826
Notes: H 8.1.1 #20826e < #20835

Chandran M. R. 2014. Is the Malaysian palm oil industry at its crossroads? Malaysian Oil Science and Technology, 23:28-48.
Reference ID: 20827
Notes: H 8.1.1 #20827e < #20835

Lenis J. I., F. Calle, G. Jaramillo, J. C. Perez, H. Ceballos, and J. H. Cock. 2006. Leaf retention and cassava productivity. Field Crops Research, 95:126-134.
Reference ID: 20828
Notes: #20828e
Abstract: Increased longevity of leaves, or improved leaf retention, has been suggested as a possible means to increase productivity of cassava (Manihot esculenta Crantz). This study evaluated variation in leaf retention and its relation to cassava productivity under irrigated and stressed conditions. In the first trial 1350 clones were evaluated on the North Coast of Colombia with a 5-month dry period towards the end of the growth cycle. Clones with the leaf retention trait produced more total fresh biomass and yielded 33% more root dry matter than plants without the trait. In the irrigated trial 110 clones were evaluated on the CIAT farm at about

1000 mamsl. Leaf retention was quantified using a 1-5 visual score with five corresponding to excellent leaf retention. Genetic correlations between leaf retention and fresh foliage production (0.49), root dry matter yield (0.46), fresh root production (0.43) and root dry matter content (0.25)were obtained. Increased root yield under stressed and unstressed conditions was associated with increased total biomass production and increased harvest index. These finding concur with the results of cassava growth models that include leaf longevity as a variable. The lack of any negative genetic correlations between leaf retention and useful agronomic traits coupled with the relatively high genetic correlation for root yield and the high heritability (0.55) for leaf retention indicate that it should be relatively easy and advantageous to incorporate this characteristic in breeding and selection programs directed to increasing root yield under both water stressed and unstressed conditions.