

New Entries to IPNI Library as References

Gerendas J., C. R. Donough, T. Oberthür, Rahmadsyah, G. Abdurrohimi, K. Indrasuara, A. Lubis, and T. Dolong. 2013. Sulphur Nutrition of Oil Palm in Indonesia - The Neglected Macronutrient. *Oil Palm Bulletin*, 67:5-10.

Reference ID: 22643

Notes: #22643e

(Note previously presented at PIPOC 2011 #18805e poster available). This article has Malay translation present

Abstract: Sulphur (S) has received limited attention by researchers, agronomists and planters involved in oil palm cultivation, despite the fact that the requirement at tissue level - as indicated by published critical concentrations in Frond #17 - is the same for S and magnesium (Mg) (0.2%). The continuous trend toward S-free fertilisers (urea, rock phosphate, KCl, dolomite) in Indonesia, together with high leaching rates of sulphate, have putatively reduced the S availability in many oil palm estates. However, this has rarely been addressed up to now. The BMP (Best Management Practice) project on sustainable oil palm intensification of the IPNI SEA programme carried out at six sites, which are representatives for current management practices in oil palm cultivation, revealed a very low S status throughout, as determined by the S concentration in Frond #17, with mean values of 0.12%- 0.13% S. After evaluating available literature a downward adjustment of the published critical S concentration - considering a critical N:S ratio of 15:1 and a critical N concentration of 2.3% - 0.15% seems appropriate. Considering the more relevant adequate N concentration range of 2.4% - 2.8%, an adequate range for S of 0.16% - 0.19% is proposed. The results clearly indicate a very low S status even when evaluated using these adjusted critical S concentrations. Researchers, agronomists and planters are encouraged to pay more attention to the S supply and to the determination of S in foliar analysis. Until the proposed critical S concentrations are supported through experimental data, it is recommended that S-containing fertilisers are administered at S-deficient sites at about 1:10 of the N supply. Potentially, a wide range of S-containing fertilisers could be used. Kieserite (MgSO₄-H₂O) seems particularly suitable due to its market availability and because both macronutrient elements contained are required in similar amounts by oil palm.

Abstrak: Keperluan sulfur (S) bagi tanaman sawit tidak diberi perhatian yang sewajarnya oleh penanam sawit dan ahli agronomi walaupun fakta menunjukkan bahawa nilai kritikal kepekatan S dan Mg untuk Pelepah 17 adalah sama (0.2%). Di Indonesia, penggunaan berterusan baja tanpa kandungan S (urea, batuan fosfat, KCl dan dolomit) serta kadar larut resap sulfat yang tinggi telah menyebabkan kedapatan S berkurangan di kebanyakan ladang sawit. Bagaimanapun, isu ini jarang diperbincangkan sehingga kini. Pihak IPNI SEA programme yang menjalankan projek amalan pengurusan terbaik (BMP) bagi sawit mampan di enam kawasan telah mendedahkan berlakunya keadaan status S yang sangat rendah dengan kepekatan S Pelepah 17 pada nilai purata 0.12%-0.13%. Selepas penilaian bahan rujukan, pelarasan menurun terhadap nilai kritikal kepekatan S dengan nisbah kritikal N:S pada nilai 15:1, maka nilai kritikal kepekatan N antara 2.3% hingga 0.15% adalah sesuai. Berdasarkan julat nilai kepekatan N yang mencukupi iaitu antara 2.4% - 2.8%, maka dicadangkan julat nilai kepekatan S yang mencukupi adalah antara 0.16%-0.19%.

Keputusan ini jelas menunjukkan bahawa status S adalah sangat rendah walaupun dinilai dengan menggunakan kepekatan kritikal S yang telah dilaraskan. Para penyelidik, ahli agronomi dan penanam sawit adalah digalakkan untuk memberi lebih perhatian terhadap bekalan S serta kepentingan penentuan status S dalam analisis daun. Sehingga nilai kritikal kepekatan S yang dicadangkan dapat disokong dengan data penyelidikan, maka disyorkan penggunaan baja mengandungi S di kawasan mengalami kekurangan S iaitu dengan nisbah 1:10 dari kadar penggunaan N. Terdapat beberapa baja yang mengandungi S yang boleh digunakan, ini termasuklah kieserit ($MgSO_4 \cdot H_2O$) yang mudah diperolehi di pasaran serta mengandungi dua makronutrien yang diperlukan dengan jumlah yang sama bagi keperluan sawit.

Xu X., P. He, M. F. Pampolino, Y. Li, S. Liu, J. Xie, Y. Hou, and W. Zhou. 2016. Narrowing yield gaps and increasing nutrient use efficiencies using the Nutrient Expert system for maize in Northeast China. *Field Crops Research*, 194:75-82.

Reference ID: 22644

Notes: #22644e

Abstract: A science-based, reliable, and feasible fertilizer recommendation method is required to respond to the low nutrient use efficiency caused by inappropriate fertilization practices. Soil test-based fertilizer recommendations are difficult to use for smallholder farms because of constraints such as access, cost and timeliness in multiple cropping systems. In this study, we combined on-farm experiments from 2012 to 2014 in 20 farmers' fields on spring maize in Northeast China with a simulation model (Hybrid Maize model), to test the continual performance in agronomic, economic and environmental aspects of the Nutrient Expert for Hybrid Maize decision support system. Six treatments were set as follows: Nutrient Expert (NE), farmers' practice (FP), soil testing (OPTS) and nitrogen (N), phosphorus (P), and potassium (K) omission treatments based on NE. We estimated yield gaps as the difference between simulated yields with the Hybrid Maize model and measured yields; calculated economic benefit and nutrient use efficiency; and estimated greenhouse gas emissions using published equations approximating nitrous oxide emissions as a function of N fertilizer rate. On average, the NE, FP, and OPTS treatments attained yields of 80%, 74%, and 77% of the potential yield, respectively. The exploitable yield gap between the NE and FP treatments was 0.9 t ha⁻¹, and between the NE and OPTS treatments was 0.5 t ha⁻¹. On average, the NE treatment increased the gross return above fertilizer cost (GRF) by US\$303 and US\$167 compared with the FP and OPTS treatments across all sites, respectively, in which about 91% and 98% of increase GRF was attributed increase in grain yield rather than reduction in fertilizer cost. There were slightly higher nutrient use efficiencies under the NE treatment than under the OPTS treatment. Relative to the FP treatment, however, on average, the NE treatment increased recovery efficiency of N, P, and K by percentage point of 12, 15, and 10, respectively. Agronomic efficiency of N, P, and K were increased by 6, 35, and 10 kg kg⁻¹, respectively. Finally, partial factor productivity increased by 14 kg kg⁻¹ for N and 45 kg kg⁻¹ for P while decreased by 29 kg kg⁻¹ for K. Furthermore, the calculated soil inorganic N at harvest of maize crop, total greenhouse gas (GHG, kg CO₂eq ha⁻¹) emissions, and GHG emission intensity (kg CO₂eq t⁻¹ grain) were 42%, 17%, and 23% lower in the NE treatment than the FP treatment, respectively. We conclude that the Nutrient Expert for Hybrid Maize system has the potential to close existing yield gaps in the spring maize production systems of Northeast China by improving yield, nutrient use efficiency, and profitability with low environmental pollution.

Abdul Hamid Z. 2011. Global Sustainability Issues with Respect to Malaysian Oil Palm Industry. Page xvii-xviii MPOB, Kuala Lumpur.

Reference ID: 22645

Notes: #22645 > S 8.1.1 #18803 Abstract only

Abstract: Clearly the 12 NKEA listed under oil palm with economic transformation potential towards becoming a high income nation would require that the country will not be clearing more land of their forests but to increase productivity per hectare on the existing land. This means that the transformation will require that the forests be maintained and enhanced. This is indeed achieved as we now have 55.6% of land under permanent forests for eco-service functions. This is also a fulfillment of the pledge made by our former Prime Minister Tun Dr Mahathir Mohammad at the Rio Summit in 1992 where Malaysia will retain 50% of its land area under permanent forests.

Choo Y. M. 2011. Malaysia's Economic Transformation Programme: the Role of the Oil Palm Industry. Page xix-xx MPOB, Kuala Lumpur.

Reference ID: 22646

Notes: #22646 > S 8.1.1 #18803 (abstract only)

Abstract: Malaysia launched its Economic Transformation Programme in 2010. The Programme, from 2011 to 2020 will transform the country from a middle income nation to become a high income nation by 2020. This entails an increase in per capita income from USD 6,700 to USD 15 000 within that period. To achieve this, 12 National Key Economic Areas (NKEA) have been identified in which the Government will focus its attention, provide all the necessary facilitation and resources including intense monitoring, to ensure that the set targets are met. One of the NKEAs is the oil palm sector. This sector is projected to contribute an increase in Gross National Income (GNI) from RM52.7 billion in 2009 to RM 178 billion in 2020. For the oil palm NKEA, eight Entry Point Projects (EPP) have been earmarked to help generate GNI. In addition various other business initiatives have identified. All these, together with normal business expansion are expected to drive the sector towards the 2020 target.

Brunskill A. 2011. Current and Future Issues and Challenges for the Oleochemical Industry. Page xxi-xxxvi MPOB, Kuala Lumpur.

Reference ID: 22647

Notes: #22647 > S 8.1.1 #18803 (slides only)

Malafa M. P. 2011. Can Lifestyle Influence Pancreatic Cancer? Page xxxvii MPOB, Kuala Lumpur.

Reference ID: 22648

Notes: #22648 > S 8.1.1 #18803 (abstract only)

Abstract: Pancreatic cancer is the most lethal cancer in our world today. It has been in the public eye lately because it has afflicted several well-known people the most prominent being the iconic Apple founder Steve Jobs who died on 10/05/11. Pancreatic cancer is known as the "silent killer" in particular because it strikes initially without symptoms. By the time symptoms appear, patient's have experienced metastases of the initial tumour to other parts of the body, which means that surgery at this stage of the disease is useless. Currently half of patients die within 5 months of their diagnosis. Even those fortunate to have their pancreatic cancer removed surgically have a grim prognosis - 5 year survival rate of 20-30%.

Charles B. A., Z. Zairizal, S. Fuad, and H. Taib. 2011. Lab Scale Efficacy Study on Metaxorb® with Various Application Rates and their Comparison with Common Chemical Control Against Rhinoceros Beetles. Pages 3-6 MPOB, Kuala Lumpur.

Reference ID: 22649

Notes: #22649 > S 8.1.1 #18803

Abstract: Biological control with pathogenic fungi is a promising alternative to chemical control against Rhinoceros Beetles. Using this fungus as the microbial insecticide is usually a part of insect pest management. In Malaysia, Cypermethrin is commonly used to control Rhinoceros beetles in oil palm plantation. In this study, various Metaxorb® application rates along with Cypermethrin against Rhinoceros beetle grubs was carried out under Completely Randomize Design (CRD) with 2 samples in 3 replications in control environment. Cypermethrin treatment that was directly applied on grubs epidermis kills faster than other treatments, however Cypermethrin that was applied surround grubs inside its incubation case shows no significant difference compare to Metaxorb® treatments.

Amit B., K. Haron, and A. A. Tuen. 2011. Avifauna Diversity in Different Peatland Ecosystems in Sarawak. Pages 7-11 MPOB, Kuala Lumpur.

Reference ID: 22650

Notes: #22650 > S 8.1.1 #18803

Abstract: The rapid expansion of oil palm cultivation especially on tropical peatland has raised serious concerns about its potential impacts on biodiversity. This paper discusses the preliminary results of avifauna species diversity and abundance in four peatland ecosystems in Sarawak comprising three forest sites with different degrees of disturbance (i.e. undisturbed, disturbed, and logged-over peatland ecosystems) and a mature oil palm plantation. A total of 740 birds representing 36 families and 96 species were mist-netted and observed and this represents approximately 15% of the total avifauna known to occur in Borneo. In terms of species richness the disturbed peatland ecosystem (64 species) was the richest, followed by undisturbed peatland ecosystem (55 species), logged-over peatland ecosystem (52 species) and mature oil palm ecosystem (21 species). In terms of species abundance of birds at the four study sites, 40% of birds were recorded at disturbed forest, closely followed by 21% in undisturbed forest and logged-over forest and 19% in oil palm plantation. Little Spiderhunter, Chestnut-winged Babbler, Red-eyed Bulbul and Red-tailed Tailorbird were the common species caught at all sites. Two species of hornbills, Asian Black Hornbill (*Anthracoceros malayanus*) and Oriental Pied Hornbill (*Anthracoceros albirostris*) are listed as totally protected and twenty one species of birds are listed as protected species under the Sarawak Wild Life Protection Ordinance 1998.

Samedani B., A. S. Juraimi, M. R. Yusop, S. A. Sheikh Abdullah, A. Abdul Rahim, and M. D. Kamal-Uddin. 2011. Weed Suppressive Ability of Cover Crops, *Mucuna bracteata* and Soft Grass, *Axonopus compressus* in Oil Palm Plantation. Pages 12-15 MPOB, Kuala Lumpur.

Reference ID: 22651

Notes: #22651 > S 8.1.1 #18803

Abstract: Weed control efficacy in oil palm using two perennial cover-crop species was evaluated on the existing four years old oil palm plantation. Experimental treatments were *Mucuna bracteata*, *Axonopus compressus* and natural vegetation as control. Treatments were carried out for 9 months in an oil palm plantation in UPM, Malaysia. *M. bracteata*, covered the ground approximately 6 months after planting (MAP). While *A. compressus* cover accomplished within 3 months after planting. *A. compressus*

produced nearly 2-fold more biomass than *M. bracteata* in 9 MAP. Cover crops significantly declined weed density and biomass. *M.bracteata* had 77-fold lower weed density and 87-fold lower weed biomass relative to control in 4 MAP. On the other hand, there were 100-fold lower weed density and weed biomass in *A.compressus* plots at the same duration (4 MAP) compared to control. The results revealed that both cover crops viz. *M. bracteata* and *A. compressus* were the strong competitors against weed due to their rapid establishment and ruderal nature.

Chin L. F., I. Bakar, D. C. Wijeyesekera, and C. M. Chan. 2011. Stabilization of Earth Road for Road Building using Probase Soil Stabilizer. Pages 16-21 MPOB, Kuala Lumpur.

Reference ID: 22652

Notes: #22652 > S 8.1.1 #18803

Abstract: Considering that a good quality road network makes effective land access possible at all, it is perhaps not too exaggerating to suggest that roads are the life lines of a nation's economic survival. Malaysia, for instance is fast developing and the need for better roads is undoubtedly growing in parallel with the nation's strive for progress. An effective road network ensures efficient delivery of goods and transportation of people directly contributing to the economic growth of the region. Due to economic reasons, not all roads can be built as paved roads, particularly in rural and plantation areas. These areas are usually connected by unpaved roads, or more commonly known as earthroads. Many problems usually arise in road building particularly on these roads such as deterioration of the surface (rutting and potholes), dusty during dry conditions and muddy during wet conditions. This research is based on the experimental work on the use of Probase powder soil stabilizer and liquid soil stabilizer for road building. Two types of soft soil samples which are from Teluk Intan, Perak and Malacca respectively will be used in this research. Physical properties tests that will be conducted are Atterberg Limits test, particle density test, moisture content test and sieve analysis test while mechanical properties test are standard Proctor compaction test, unconfined compressive strength (UCS) test and resilient modulus (RM) test. All these tests will be conducted in accordance to BS1377:1990. The suitability of stabilized soils using Probase soil stabilizers for road building will be determined. It is expected that Probase soil stabilizers will be able to stabilize the soft soils for road building besides reducing construction and maintenance costs, also ensure the roads remain passable during rainy season and dust-free in dry season.

Hansen S. B., S. I. Olsen, and Z. Ujang. 2011. Oil Palm Plantations and Biodiesel - Land Use Change Impacts on the Carbon Balance. Pages 22-26 MPOB, Kuala Lumpur.

Reference ID: 22653

Notes: #22653 > S 8.1.1 #18803

Abstract: The topic of land use change impacts from palm oil production heavily debated and often twisted by stakeholders. Thus academic objectivity is needed. This study provides a critical review on quantification of the GHG emissions conversion of secondary forest to oil palm plantation in Malaysia per ha in relation to biodiesel production. The results show a net emission of 560kg CO₂/ha of land converted, which results in a land use change emission of 3.4 ton CO₂/ton biodiesel from first generation plantations on secondary forest. One national average ton of palm oil derived biodiesel has a land use change emission of 0.9 ton CO₂ resulting in total emissions of 1.7 to 2.1 ton CO₂/ton including the production stage depending on whether methane is captured from the POME digestion.

Shazril M. Z. and C. C. Tey. 2011. Effect of Arbuscular Mycorrhizal Fungi on Growth of Oil Palm Seedlings. Pages 32-35 MPOB, Kuala Lumpur.

Reference ID: 22654

Notes: #22654 > S 8.1.1 #18803

Abstract: Arbuscular mycorrhizal fungi (AMF) are symbiotic fungi that form a beneficial relationship with the roots of almost 80% land plant species. This symbiotic relationship may benefit plant in enhancing plant's growth rate through increased soil nutrient absorption and water uptake, and improved tolerance to root pathogens. Sime Darby Plantation R&D Centre has produced an AMF product consisting of five species of AMF. Two trials were conducted to evaluate the effectiveness of the product with respect to growth enhancement in oil palm seedlings.

Nor Sarashimatun S., C. L. Teh, and C. C. Tey. 2011. Evaluation of Beneficial Plants as Hosts for Natural Enemies of Oil Palm Bagworms. Pages 36-40 MPOB, Kuala Lumpur.

Reference ID: 22655

Notes: #22655 > S 8.1.1 #18803

Abstract: Crop losses as a result of bagworm attack on oil palm are significant, with 30-50 percent yield reduction when there is serious defoliation. In biological control of bagworm, a wide range of weeds and understorey plants has been associated with the encouragement of bagworm natural enemy activity. This study investigates new host-plants for natural enemies of bagworm *Metisa plana* where four trials were carried out.

Teh C. L., A. Zakaria, and C. C. Tey. 2011. Importation Procedure and Breeding of the Barn Owl in Captivity. Pages 41-45 MPOB, Kuala Lumpur.

Reference ID: 22656

Notes: #22656 > S 8.1.1 #18803

Abstract: The barn owl, *Tyto alba javanica*, is an effective biocontrol agent of rats in oil palm industry in West Malaysia and Indonesia. This bird species, however, has not been recorded in any appreciable numbers in Sabah and Sarawak. Earlier attempts by at least three plantation agencies to import from West Malaysia and release the raptors into East Malaysian estates somehow failed to get them established, despite owl boxes were set up in the field. A more recent project on the importation of the barn owl was initiated by the Research and Development Unit of Malaysian Palm Oil Association, Sabah Branch about five years ago. After much hassle, the Wildlife Department and Veterinary Department both in East and West Malaysia have finally given the green light to allow Sime Darby Plantation to take the lead to import barn owls from West to East Malaysia.

Azlina Z. and C. C. Tey. 2011. Killing Efficiency of Selected Insect Predator Species against Bagworm, *Metisa plana*. Pages 46-49 MPOB, Kuala Lumpur.

Reference ID: 22660

Notes: #22660 > S 8.1.1 #18803

Abstract: The asopin bugs, *Platynopus melacanthus* and *cantheconidea furcellata* (Hemiptera: Pentatomidae) and assassin bugs, *Sycanus dichotomus* and *Cosmolestes picticeps* (Hemiptera: Reduviidae) are common insect predators of oil palm bagworms. These predator species attack bagworm larvae, the stage which is causing damage (leaf defoliation) to oil palm fronds. The action of these predators has often been observed in the oil palm field, but quantification of their killing ability is lacking. Study was carried out in the insectary at Sime Darby Plantation R&D Centre

to evaluate the bioefficacy of these predator insects towards the control of bagworm, *Metisa plana*.

Cheong Y. L. and C. C. Tey. 2011. Checkered Beetle, *Callimerus arcufer* (Coleoptera:Cleridae) and its Predation Activity on Bagworms, *Metisa plana* and *Pteroma pendula*. Pages 50-53 MPOB, Kuala Lumpur.

Reference ID: 22661

Notes: #22661 > S 8.1.1 #18803

Abstract: Macrofauna natural enemies of bagworms in particular arthropods are one of the important factors in keeping the population of these caterpillar pests regulated in nature. The IPM approach of establishing beneficial plants and introducing various species of hemipteran predators for bagworm management in oil palm plantations are examples of efforts by Sime Darby Plantation to minimize the usage of chemical pesticides and to promote pest management through environment friendly methods. Checkered beetle *Callimerus arcufer* (Coleoptera:Cleridae) has been reported as a common predator of bagworms in Malaysia but is not fully utilized as its role in controlling the bagworm population has not been investigated. This study, *C. arcufer* and its predation behaviour against bagworms, *Pteroma pendula* and *Metisa Plana* were studied. Preliminary observation showed that both the larvae and pupae of the two bagworm species were actively attacked by the larvae of *C. Arcufer* under laboratory conditions; the pupal stages were the preferred target of attack. Thus, there is good potential of using *C. arcufer* for biological control of bagworms, mainly on *M. plana* and *P. pendula*, to complement the current use of hemipteran predators and parasitoids in oil palm plantations developed at Sime Darby Plantation R&D Centre.

Normahnani M. N. and C. C. Tey. 2011. Evaluation of Effective Microorganisms for Ganoderma Control in Oil Palm Seedlings. Pages 54-57 MPOB, Kuala Lumpur.

Reference ID: 22662

Notes: #22662 > S 8.1.1 #18803

Abstract: The effectiveness of seven isolates of selected effective microorganism (EM) viz. *Trichoderma* spp. (GY10, C15 and FF19), actinomycetes (FF12, BLM747 and BLM 1287) and bacteria *Pseudomonas aeruginosa* (BX42) was evaluated in nursery trial for the control of *Ganoderma boninense* infection in oil palm seedlings. 100g of EM product was applied using two different methods, i.e. during the time of seed sowing and during transplanting to main nursery. The disease progression was assessed using the percentage of disease incidence (%DI) and percentage of disease severity (%DS). Trial results showed the ganoderma disease developed much slower in seedlings treated with EM compared with untreated seedlings. Among the three groups of microorganisms tested, *Trichoderma* spp. was the most effective in controlling the disease with 43% to 85% reduction in *Ganoderma* incidence, followed by *Pseudomonas aeruginosa* with 50% to 65% and actinomycetes with 30% to 67% disease reduction, in comparison with untreated seedlings where there was 100% infection. All the EM treated seedlings also demonstrated lower disease severity with 12% to 48% for *Trichoderma* spp., 26% to 40% for *Pseudomonas aeruginosa* and 29% to 58% to actinomycetes in comparison with 100% disease severity for the control seedlings. In addition, the plant biomass of the EM treated seedlings for all Em treatments was significantly higher compared to the control.

Abd Razak I. B. and S. Meon. 2011. Effect of Endophytic Bacterial Formulation on Suppression of Ganoderma Infection in Oil Palm Seedlings. Pages 58-61 MPOB, Kuala Lumpur.

Reference ID: 22663

Notes: #22663 > S 8.1.1 #18803

Abstract: Endophytic bacteria *Burkholderia* sp. (UPM B3) and *Pseudomonas* sp. (UPM P3) were formulated as dry formulation using vermiculite and coir dust carriers, with Luria broth as the source of nutrient. Developed bacterial formulations were assessed for their efficacy against *G. boninense* infection towards 3-month old oil palm seedlings in every monthly interval for nine months. The oil palm seedlings were pre-inoculated with developed bacterial formulations and then inoculated with *Ganoderma* Rubber wood block (RWBs) 7 days later. After nine months of assessment, seedlings applied with formulations containing UPM P3 in vermiculite and coir dust showed the least percentage of Disease severity (DS%) with respective values of 17% and 20% compared to other treatments. Results also showed that seedlings treated with mix culture formulations in both vermiculite and coir dust have lower DS% of 32% and 41% than seedlings treated with formulations containing UPM B3 in both vermiculite and coir dust with values of 45% and 46% respectively.

H Saadiah O. and M. M Nasruddin. 2011. A Comparative Study on the Effectiveness of Nuclear Magnetic Resonance (NMR) Analyser over the Conventional Method in Determining the Palm Oil Content in the Bunch Analysis Process. Pages 62-65 MPOB, Kuala Lumpur.

Reference ID: 22664

Notes: #22664 > S 8.1.1 #18803

Abstract: A comparative study was conducted to test the potential of NMR in determining the palm oil content over the conventional method practiced in the bunch analysis process. A total of 100 samples, each from a single palm were used to determine the palm oil content using both the NMR analyser and the conventional methods. Results from both methods were evaluated for the oil content as well as other bunch components derived from the bunch analysis process. Calibration equations for palm oil contents and other traits in both NMR and the conventional methods were developed.

Siti Nor'aini A. and H. Noor Hisham. 2011. Effect of Temperature and Relative Humidity on the Survival of Conidiospores of *Metarhizium anisopliae* var. major in Powder Formulation. Pages 66-70 MPOB, Kuala Lumpur.

Reference ID: 22665

Notes: #22665 > S 8.1.1 #18803

Abstract: Powder formulation of *Metarhizium anisopliae* var. major (ORY-X) for the biological control of *Oryctes rhinoceros* is the main product under the collaboration between Malaysian Palm Oil Board (MPOB) and FELDA Agricultural Services Sdn Bhd. One of the major problems in the production of this product is the lifespan of the final product. A study on the effect of temperature and relative humidity on the survival of conidiospores during storage in the powder formulation was carried out with the objective to improve the shelf life of the end product.

Chin L. F., I. Bakar, and C. M. Chan. 2010. Stabilization of Earth Road for Road Building using Probase Soil Stabilizer. EJGE, 15:1793-1814.

Reference ID: 22666

Notes: #22666e

Abstract: Considering that a good quality road network makes effective land access possible at all, it is perhaps not too exaggerating to suggest that roads are the life lines of a nation's economic survival. Malaysia, for instance, is fast developing and the need for better roads is undoubtedly growing in parallel with the nation's strive for progress. An effective road network ensures efficient delivery of goods and transportation of people, directly contributing to the economic growth of the region. Due to economic reasons, not all roads can be built as paved roads, particularly in rural and plantation areas. These areas are usually connected by unpaved roads, or more commonly known as earthroads. Many problems usually arise in road building particularly on these roads such as deterioration of the surface (rutting and potholes), dusty during dry conditions and muddy during wet conditions. This research is based on the experimental work on the use of Probase powder soil stabilizer and liquid soil stabilizer for road building. Two types of soft soil samples which are from Teluk Intan, Perak and Malacca respectively will be used in this research. Physical properties tests that will be conducted are Atterberg Limits test, particle density test, moisture content test, and sieve analysis test while mechanical properties test are standard Proctor compaction test, unconfined compressive strength (UCS) test and resilient modulus (RM) test. All these tests will be conducted in accordance to BS1377:1990. The suitability of stabilized soils using Probase soil stabilizers for road building will be determined. It is expected that Probase soil stabilizers will be able to stabilize the soft soils for road building besides reducing construction and maintenance costs, also ensure that the roads remain passable in rainy season and dust-free in dry season.

Zainal Abidin C. M. R., N. H. Hamid, S. T. Ismail, and A. H. Ahmad. 2011. Field Evaluation of Mating Behaviour of Male Moth Towards Receptive Female of the Bagworm, *Metisa plana* (Lepidoptera: Pscyhididae). Pages 71-74 MPOB, Kuala Lumpur.

Reference ID: 22668

Notes: #22668e > S 8.1.1 #18803

Proceedings of Agri Kuala Lumpur

Abstract: The receptive female (RF) of *Metisa p/ana* (Lepidoptera: Pscyhididae) is wingless, and most of her body consists of an abdomen full of unfertilized eggs. The matured female dehisces the anterior part of her pupae case and releases pheromone-impregnated scales into the lower end of the bag. Upon landing on the bag of receptive female, the male inserts and extends his abdomen four to five times long through the posterior bag opening to reach the female's genitalia for copulation. In field experiments, more than one winged male are attracted to a female at any one time but only one male inserts the body through the posterior female bag. Some significant relationships were found between mating activity of *M. plana* between temperature and relative humidity. Results indicated that the mating activities were significantly high during the early morning. These results suggest that the successful mating behavior of *M. plana* was influenced by temperature and humidity.

Priwiratama H., A. Susanto, and Surianto. 2011. Physical Barrier on the Oil Palm Trunk: An Approach to Prevent Upper Stem Rot Disease Caused by *Ganoderma boninense*. Pages 79-83 MPOB, Kuala Lumpur.

Reference ID: 22669

Notes: #22669 > S 8.1.1 #18803

Abstract: *Ganoderma boninense* is one of the major pathogens of oil palm, especially in Southeast Asia, which had been formerly known as the causal agent of basal stem

rot (BSR) disease. The study conducted at PT. Anak Tasik, Labuhan Batu, North Sumatra showed that *G. boninense* also caused upper stem rot (USR) disease. The disease incidence could exceed 35% in 2007 and has become the major form of *Ganoderma* disease in the peatland oil palm plantation, which disperses by the airborne-basidiospore. The use of plastic mulch as a physical barrier with aims to prevent spore-landing on the trunk is being carried out. Application of triadimenol through trunk injection and non-treated palm as a control were used as comparison. Current result shows that the disease incidence of *Ganoderma* occurs in all treatments. The disease incidence in the barrier-treated palm reaches 5.7% (six out of 118 palms) in which two palm positively infected by USR, determined by the occurrence of fruiting body on the upper-part stem. This result shows that basidiospore has penetrated the trunk before physical barrier application conducted.

Murugesan P. and G. Mandal. 2011. Identification and Characterization of Three Pisifera Palms. Pages 84-88 MPOB, Kuala Lumpur.

Reference ID: 22670

Notes: #22670 > S 8.1.1 #18803

Abstract: thirty one accessions of four different sources planted during 1998 in the field gene bank at Directorate of Oil Palm Research (DOPR), Research Centre, Palode, Kerala, India were evaluated during 2006-07 to 2009-10. Three pisiferas, one tenera and 83 dura palms were identified out of 87 palms as per fruit form analysis. The section of results pertaining to pisiferas is presented in this paper. Characterization of pisifera palms was carried out of their possible utilization. The characterization revealed that one psisfera (DOPRG-53-E66) showed fertile character which recorded normal bunch and fruit development with 25% Fruit to Bunch whereas, other psisferas (DOPG-53-E-75 and DOPRG-54-E65) showed aborted bunches throughout the evaluation period. However, DOPRG-54-E65 found to set few fruit twice with virescence fruit pigmentation and shell-less kernel. DOPRG-53-E66, DOPRG-54-E65 and DOPRG-53-E-75 palms had average height increment of 65.1, 69.2 and 55.1cm per year, respectively. Suitable sterile pisifera palms could be selected as promising palms after progeny testing for commercial hybrid seed production.

Tuen A. A., N. Kamaruddin, M. Abdul Rahman, and C. J. Laman. 2011. Avifauna in a Logged Over Forest in Belaga, Sarawak. Pages 89-94 MPOB, Kuala Lumpur.

Reference ID: 22671

Notes: #22671 > S 8.1.1 #18803

Abstract: Land clearing for agriculture is expected to have a negative impact on biodiversity because of habitat destruction leading to loss of food and shelter as well as stress, injury and death especially of slow moving individuals during the clearing phase. However, if a portion of the plantation is retained in its original state for the purpose of conservation then the impact on biodiversity should be less because the wildlife is expected to utilise these conserved areas. At a logged over forest reserved for a smallholder oil palm plantation near Belaga, Sarawak, three strips of hill forest approximately 100m wide and more than 1km long have been left intact for this purpose. To find out whether birds move from the cleared area and reside in the conserved area, we sampled within the forest using mist-nets before it was cleared for oil palm in December 2008 and after clearing took place we sampled the conserved strip in June and Nov 2010.

Suswanto T., A. Sugandi, and K. J. Goh. 2011. Lower Frond Desiccation of Oil Palm Grown in Deep Peat in Riau, Indonesia. Pages 95-99 MPOB, Kuala Lumpur.

Reference ID: 22672

Notes: #22672 > S 8.1.1 #18803

Abstract: One of the agronomic problems faced in planting oil palm in deep peat is the desiccation of lower fronds, which can reduce yield significantly. A study was therefore conducted to identify the causal factors and to investigate the effect of various ameliorative treatments to palms with frond desiccation symptoms. Three experiments were carried out to achieve the objectives of the study. The first experiment was designed to identify the differences in soil properties and nutritional status of palms with and without frond desiccation symptoms. The second experiment was carried out to study the effect of rock phosphate on frond desiccation while the third experiment evaluated various ameliorative treatments to overcome the frond desiccation problems.

Susanto A. and A. F. Lubis. 2011. Latest Results of Surgery and Mounding to Control *Ganoderma* in Oil Palm Plantation. Pages 100-103 MPOB, Kuala Lumpur.

Reference ID: 22673

Notes: #22673 > S 8.1.1 #18803

Abstract: Basal Stem Rot disease of oil palm caused by *Ganoderma boninense* which is a soil borne pathogen is very difficult to control. Commonly, oil palm infected by *Ganoderma* will not be recovered or become dying slowly. But, observations in the field showed that there were some recovered palms after the infection. The objective of this research was to stop *Ganoderma* infection process in the field by infected tissue surgery followed by mounding.

Darlan N. H., E. Listia, and H. H. Siregar. 2011. Oil Palm Characteristics on High Altitude. Pages 104-107 MPOB, Kuala Lumpur.

Reference ID: 22674

Notes: #22674 > S 8.1.1. #18803

Abstract: Sciences have shown that climate change and global warming has happened all over the world, including Indonesia, after era industry. Climate change implications in Indonesia are increasing temperature, drier dry season, and higher flood intensity in the rainy season. The increasing temperature may lead to oil palm expansion in the high altitude (>600m). Nowadays, oil palm area in high altitude in North Sumatra province is 4.725 ha (planting year 1996-2007), and 4.772 ha at West Java (planting year 2002-2007). The oil palm performances at high altitude generally have some characteristics which are different than oil palm in the low altitude.

Mohd As'wad A. B., M. Sariah, R. R. M. Paterson, M. A. Zainal Abidin, and N. Lima. 2011. Detection and Quantification of Ergosterol in Oil Palm Infected with *Ganoderma*. Pages 108-111 MPOB, Kuala Lumpur.

Reference ID: 22675

Notes: #22675 > S 8.1.1. #18803

Abstract: The present report compares ergosterol concentration in *Ganoderma* mycelia biomass, healthy and decayed oil palm (OP) tissues. The sterol was correlated with internal colonization (a) of felled and standing OP and (b) to external symptoms of the disease. The compound was not detected in healthy samples. Ergosterol detection and quantification is a provisional diagnostic method for detection of *G. boninense* infection in P which can be employed with other methods, enabling early remedial action to be taken. This represents the first data published on the use

of ergosterol analysis as a diagnostic method to detect BSR and indicates a new direction of research in BSR management.

Abdul Bahar H., S. N. Akmar Abdullah, H. Khaza'ai, and S. Meon. 2011. Isolation of Gamma-tocopherol Methyltransferase Full Gene Structure from Oil Palm. Pages 112-116 MPOB, Kuala Lumpur.

Reference ID: 22676

Notes: #22676 > S 8.1.1. #18803

Abstract: Oil palm, *Elaeis guineensis*, is the main commodity crop in Malaysia. It is nature's richest source of tocotrienols which are surprisingly not found in most other vegetable oils. The total vitamin E (1,000 ppm) in palm oil is composed of 70% tocotrienols and 30% tocopherols, whereas the vitamin E content in most other vegetable oils consists of only tocopherols. This has brought interest to carry out functional characterization of vitamin E key biosynthetic genes from oil palm. In this research, one of the key enzymes of vitamin E biosynthesis genes, gamma-tocopherol methyltransferase (γ -TMT), was isolated from oil palm at genomic level. Primers were designed based on γ -TMT gene sequence in Genbank. A partial genomic γ -TMT DNA fragment was sequenced and revealed its genomic structure, which consist of 5 exons and 4 introns. In order to isolate promoter region of γ -TMT gene, genome walking technique was used. Initial attempt resulted in a discovery of another intron. Starting from the next exon region upstream from the discovered intron, the second attempt resulted a 745 bp long DNA fragment. This DNA fragment was compared with DNA sequence from 5' RACE and was confirmed that only 247 bp consists of the promoter region of γ -TMT. Analysis using PLACE to determine the cis-acting regulatory DNA Elements revealed some common motifs such as TATA-box, CAAT-box, GATA-box and Dof element. Compilation of these genomic DNA sequence bring a total of 4952 bp including the promoter region. The remaining region apart from 5' and 3' untranslated region (UTR) consists of 6 exons and 5 introns as analyzed using megablast tool.

Lim G. T. and P. V. V. Ho. 2011. A Comparative Study on the Effect of Organic Acid and Lipid Ester on *Ganoderma*-infected Oil Palm. Pages 117-121 MPOB, Kuala Lumpur.

Reference ID: 22677

Notes: #22677 > S 8.1.1. #18803

Abstract: *Ganoderma boninense* is currently the most serious fungal disease of oil palm. It is threatening the oil palm industry in Malaysia with increasing ferocity. The significant economical loss in either direct (collapsed palm) or indirectly effect (FFB and OER) caused by this disease was well-documented. Thus various control methods have been carried out in particular the fungicide treatment, biological control as well as cultural practices e.g. soil mounding, removing the infected palms, for the control of this disease. So far, no satisfactory results were obtained. An assessment of an array of new products was recently carried out in which a comparative study of *Ganoderma* control was made by using 0.2% v/v organic acid (Engano 211 and Engano 212), lipid ester (Palm Booster) and control (water) respectively. The mode of application was by means of a combination of trunk injection, soil drenching and spraying on the trunk and on the fruiting bodies of the infected palms. The schedule of treatment was on weekly basis for the first month, 10 days interval for the second month and thereafter monthly treatment up to the fifth month.

Maizatul S. M. and A. S. Idris. 2011. Survey on the Occurrences Noxious Weeds in Immature Oil Palm Plantations in Malaysia 2008-2009. Pages 122-125 MPOB, Kuala Lumpur.

Reference ID: 22678

Notes: #22678 > S 8.1.1. #18803

Abstract: A questionnaire survey was conducted by Malaysian Palm Oil Board (MPOB) to gain information on noxious weeds in immature oil palm estates in Malaysia. For grass weeds, highest percentage of the respondents has *Eleusine indica* (82.2%) in their immature oil palm estates followed by *Imperata cylindrica* (81.2%), *Ischaemum muticum* (71.8%) and *Pennisetum polystachion* (67.1%). As for broadleaf weeds, highest percentage of the respondents has *Mikania micrantha* (77.2%) in their estates, followed by *Clidemia hirta* (74.6%), *Asystasia intrusa* (74.2%), *Melastoma malabathricum* (72.0), *Chromolaena odorata* (67.7%), *Hedyotis verticillata* (64.3%), *Mimosa sp.* (59.6%) and *Lantana camara* (55.3%). Sedges and ferns were found in 51.4% and 74.4% of the estates surveyed. Weed emerged from uncollected oil palm loose fruits, volunteer oil palm seedlings (VOPS) was reported to be found in 63.9% of the Malaysian oil palm estates.

Latif S. 2011. A Preliminary Study: The Application of "Corona Glow Discharge Plasma" Technology for Enrichment the Nitrogen Content of Empty Fruit Bunch Compost. Pages 126-129 MPOB, Kuala Lumpur.

Reference ID: 22679

Notes: #22679 > S 8.1.1. #18803

Abstract: The "corona glow discharge plasma" (CGDP) technology has been applied in many aspects of agriculture, food industry, renewable energy and environment. It has been applied to promote growth of variety of plants since it could enrich the nitrogen content of seed or other part of planting material. It could also be applied in similar way to enrich the nitrogen content of compost that made from empty fruit bunch (EFB).

Virdiana I., J. Flood, B. Sitepu, Y. Hasan, R. Aditya, and S. Nelson. 2011. Integrated Disease Management to Reduce Future *Ganoderma* Infection during Oil Palm Replanting. Pages 130-134 MPOB, Kuala Lumpur.

Reference ID: 22680

Notes: #22680 > S 8.1.1. #18803

Abstract: Two long term field trials were established in 2000 and 2001 in PT PP London Sumatra Indonesia Tbk's North Sumatra Dolok estate to investigate methods to reduce palm losses to *Ganoderma* infection. There is great variation between estates in North Sumatra but usually *Ganoderma* infection starts to appear about 7-8 years after field planting in second generation oil palm plantings. The objective of these trials was to investigate whether various replanting techniques will reduce the rate of palm losses to *Ganoderma* over approximately 25 years after field planting and not just during the first few years after planting.

Mos H., M. H. Harun, N. M. Jantan, and M. R. Mohd Noor. 2011. Monitoring CO₂ Emissions from a Newly Logged-over Peat Swamp Area in Sarawak. Pages 140-143 MPOB, Kuala Lumpur.

Reference ID: 22681

Notes: # > S 8.1.1 #18803 Proceedings of Agri Kuala Lumpur

Abstract: Drainage and cultivation of peat soils lead to subsidence and stimulates soil organic matter mineralization that substantially increases C loss as CO₂ emission from

soils. Carbon loss has mainly been considered as an agricultural problem, especially when the peat is drained. The objective of the current study was to provide the baseline of greenhouse gases emissions from a newly cleared logged-over peat swamp area using flux techniques.

Wong M. Y., J. Chua, S. N. Akmar Abdullah, and A. Othman. 2011. Molecular Analyses of Nonribosomal Peptide Synthetase in *Ganoderma boninense* Pat. Pages 144-147 MPOB, Kuala Lumpur.

Reference ID: 22682

Notes: #22682 > S 8.1.1 #18803

Abstract: Oil palm plays a significant role in Malaysia's economy as Malaysia is the second largest palm oil producer in the world. However, basal stem rot caused by *Ganoderma boninense* remains as an unresolved problem in most production areas. This is due to the fact that little is known about the infectious process of this fungus at the molecular level. Wood-decaying fungi produce secondary metabolites especially those produced by nonribosomal peptide synthetase (NRPS) that are toxic to host plants from have been implicated as a virulence factor. It is interesting to know if NRPS plays a role in the virulences of *G. boninense*-oil palm interaction. In this work, the detection of NRPS in *G. boninense* was achieved using PCR and biochemical methods. Since the NRPS genes are large (>10kb), amplification was targeted to the adenylation domain which act as the selector and the activator of toxin biosynthesis.

Bahariah B., G. K. A. Parveez, and N. Khalid. 2011. Evaluation of Mannose as an Effective Selection Agent for Transformed Oil Palm Cells Using the Phosphomannose Isomerase (*pmi*) as a Positive Selectable Marker Gene. Pages 148-152 MPOB, Kuala Lumpur.

Reference ID: 22683

Notes: #22683 > S 8.1.1 #18803

Abstract: To establish a selection system that utilizes the phosphomannose isomerase (*pmi*) gene for oil palm transformation, we first determined the optimal concentration of mannose effective for selecting the transformed from non-transformed cells. Non-transformed embryonic calli were cultured on media containing various combinations and concentrations of mannose and a usable source in plant tissue culture ranging in content from 0 to 30 g/l. Sucrose is often used as a carbon source in plant tissue culture.

Nor Azwani A. B., A. Mohd Din, N. Rajanaidu, and A. Noh. 2011. Preliminary Evaluation of the Intercrosses (Nigerian TxT) and their Outcrosses (Nigerian TxT UP) Breeding Population. Pages 153-156 MPOB, Kuala Lumpur.

Reference ID: 22684

Notes: #22684 > S 8.1.1 #18803

Abstract: A total of eight outcrossed between Nigerian teneras and UP teneras and nine intercrossed Nigerian teneras in Trial 0.319 in MPOB Keratong were evaluated. Assessment for yield, bunch analysis and vegetative traits has been conducted to study the performance of the Nigerian teneras outcrosses and TxT Nigerian intercrosses. The mean fresh fruit bunch (FFB) for both Nigerian crosses (outcrosses and intercrosses) were higher with 154.94 kg/p/yr respectively as compared to the standard cross (DxP control) which give only 133.00 kg/p/yr. Both Nigerian crosses revealed moderate oil to bunch (O/B) with mean 22.80% and 22.32% respectively while the standard cross palms obtained higher O/B with 24.36%. However, the height of the Nigerian crosses seem promising with mean of 2.00m and 1.83m for outcrosses and intercrosses respectively, while the standard cross showed a tail stature of 2.74m.

The lowest mean for height was 1.33m which comes from Nigerian intercrops. On the whole, the performance between both Nigerian crosses indicated the Nigerian outcrossed with UP teneras performed slightly better than Nigerian intercrops in term of FFB and BNO production. The crosses materials showed a better performance in term of FFB yield and dwarfness while O/B is comparable to the DxP control.

Moslim R., N. Kamarudin, and M. B. Wahid. 2011. Production of Aerial and Submerged Spores of *Metarhizium anisopliae* var. *major* on Media Supplemented with Palm Kernel Cake. Pages 157-160 MPOB, Kuala Lumpur.

Reference ID: 22685

Notes: #22685 > S 8.1.1 #18803

Abstract: Production of aerial and submerged spores of *Metarhizium anisopliae* var. *major* was estimated on media supplemented with palm kernel cake (PKC). The aerial spores of *M. anisopliae* var. *major* was produced in autoclavable plastic bags with 120g maize supplemented with palm kernel cake. Adding PKC at 5g/bag and 10g/bag produced 4.3g and 5.6g spores, significantly higher than yield of spores produced on maize alone (2.03g). Growing of *M. anisopliae* var *major* in a simple liquid medium consisting of 5g glucose and 5g PKC produced submerged spores or termed as blastospores. Formation of blastospores during the fermentation process was monitored. Young blastospores are round to ovoid with 5.0-5.5 µm in diameter and matured blastospores are ellipsoid with dimension of 5.0-5.5µm x 12.5-15.5µm. The highest yield of blastospores was 3.26x10⁶ blastospores/ml produced at 7 days after fermentation. The aerial spores and blastospores were equally effective to control the third instars larvae of *Orcytes rhinoceros*. At 14 days after treatment, both inoculums caused between 94.3% and 97.1% mortality. The LD₅₀ values for both inoculums were about the same, which are 9.1 days for aerial spores and 9.5 days for blastospores.

Rusfiandi H., A. Sitorus, B. P. Forster, S. P. C. Nelson, and P. D. S. Caligari. 2011. Oil Palm Fruit Development. Pages 161-166 MPOB, Kuala Lumpur.

Reference ID: 22686

Notes: # > S 8.1.1. #18803 Proceedings of Agri Kuala Lumpur

Abstract: As a crop of world-wide importance, it is surprising that so little is published on oil palm fruit development especially as the fruit is the harvestable product. We describe oil palm fruit development from observations beginning at the mature unpollinated pistil, to two days after pollination and onwards to fruit maturity. The study traces and compares fruit development of the three main fruit types: dura (thick shelled), tenera (thin shelled) and pisifera (shell-less). The study showed that in dura and tenera fruits, the endosperm solidification stage coincided with the formation and hardening of the shell surrounding the kernel. This was a gradual process. Dura and tenera fruits exhibited similar development patterns and developmental rates. The shells in both dura and tenera fruits are derived from the inner mesocarp tissue. The development of pisifera fruits is different in that no shell is formed during the endosperm solidification phase. It is hypothesized that endosperm and shell development are synchronized and controlled by the same signal(s) which may be hormonal. The study provides a means of determining fruit age by observing certain physiological features in sampled fruits. Key physiological events may be targeted for gene function studies in fruit development.

Rusfiandi H., S. Wening, H. E. Iswandar, S. P. C. Nelson, and P. D. S. Caligari. 2011. A New *in vivo* *Pisifera* Seed Germination Protocol. Pages 167-171 MPOB, Kuala Lumpur.

Reference ID: 22687

Notes: #22687 > S 8.1.1. #18803

Abstract: *Pisifera* oil palms are often female sterile. Fertile *pisiferas* do occur, but have shell-less fruits. The seeds of these are difficult to germinate using conventional commercial seed production methods. Production of *pisifera* palms are important as they are used in crosses with *dura* (thick-shelled) palms to produce the commercially grown *tenera* of medium shell thickness. A simple efficient method to germinate *pisifera* seed has been developed, which is described and displayed. Key features are kernel excision, surface sterilization of the kernel, the removal of operculum and incubation of treated seed. Using this system germination begins promptly within one week of treatment and seedlings established. The significance of this method to oil palm breeders are discussed. The method may also be exploited on old batches of *tenera* breeding seeds, interspecific crosses and oil palm polypoids.

Malike F. A., N. Abdullah, and N. Ahmad. 2011. Evaluation of Harvest Index in the MPOB Germplasm Collections. Pages 172-175 MPOB, Kuala Lumpur.

Reference ID: 22688

Notes: #22688 > S 8.1.1. #18803

Abstract: Ten trials of oil palm (*Elaeis guineensis* Jacq.) which involved five germplasms from the Malaysian Palm Oil Board (MPOB) germplasms collections, namely, Tanzania, Senegal, Guinea Conakry and Ghana were evaluated for harvest index (HI), i.e. the proportion of dry matter used for the production of oil and kernels, respectively. Estimation of HI requires the measurement of trunk height, trunk diameter, rate of frond production and petiole cross-section. Fresh Fruit Bunch (FFB) from the yield recording activity and oil to bunch (O/B) from the bunch analysis were also used in calculating HI. However, the estimation neglects the kernel oil. All the data collected were analysed by using analysis of variance (ANOVA), while the comparison between the germplasm means was by Fisher's Least Significant Difference (LSD) at the minimum 5% level of probability. The Tanzanian germplasm showed the highest mean of HI and significantly different than the other germplasm for both *duras* (HI = 0.56) and *teneras* (HI = 0.55). Meanwhile, high variation of HI was found in the Guinea Conakry germplasm with coefficient of variation of 8.50% for *duras* and 8.13% for *teneras*.

Ocampo, A., Pampolino, M., Luar, L., Pedro, R., How, M., Cosico, V. L., Santos, E. D., Hilado, S., Valdez, A., Santos, P. J., Oberthür, T., and Shcherbakov, A. Nutrient Management For Cassava In The Philippines. 2016. Philippines, IPNI.

Reference ID: 22689

Notes: #22689e

Presented in 46th Crop Science Society of the Philippines Conference 13-18th June 2016, Phela Grande Hotel, General Santos City, Philippines

Abstract: Cassava is an important crop in the Philippines used as food, feed, and raw material for industrial products. The current yield of cassava is only about 12 t/ha, while yields >75 t/ha (fresh weight) are possible under controlled conditions (FAO, 2013). Whilst it is known that cassava responds to fertilization, there is a lack of quantitative knowledge on the response of cassava to fertilizer under specific biophysical conditions, which are important in the development of an improved nutrient management strategy for cassava (FAO, 2013).

Fassbender H. W., J. Beer, J. Heuvelop, A. Imbach, G. Enriquez, and A. Bonnemann. 1991. Ten year balances of organic matter and nutrients in agroforestry systems in CATIE, Costa Rica. *Forest Ecology and Management*, 45:173-183.

Reference ID: 22690

Notes: H 9 #22690e

Abstract: In the 'Experimento Central' of CATIE (Centro Agronómico Tropical de Investigación y Enseñanza, Turrialba, Costa Rica) studies on organic matter and nutrient cycling have been carried out in the following agroforestry systems, planted in 1977:

- *Theobroma cacao* with *Cordia alliodora* and *Erythrina poeppigiana*;
- *Coffea arabica* with the same shade trees;
- *Cynodon plectostachyus* (star grass) associated with the same trees.

Results are presented and discussed using the *T. cacao* systems as an example. The accumulation of organic matter, measured for the different species (leaves, branches, trunks, roots, fruits and litter) at an age of 5 years (1982) and of 10 years is very large: 50.3 and 110.6 t ha⁻¹ for *T. cacao/C. alliodora*. The average cacao bean harvest at an age of 6-10 years reached 1036 and 1057 kg ha⁻¹ under shade of *C. alliodora* and *E. poeppigiana*, respectively. Total stem volume growth of *C. alliodora* is presently 9.6 m³ ha⁻¹ a⁻¹. Measurements of the natural leaf fall and of prunings were made over 5 years, reaching 8.1 and 13.29 t ha⁻¹ a⁻¹ for *T. cacao/C. alliodora* and 9.29/13.57 t ha⁻¹ a⁻¹ for *T. cacao/E. poeppigiana*, respectively. With the values obtained, quinquennial models for organic matter and nutrients are presented and discussed.

Nesadurai H. E. S. 2013. Food security, the palm oil-land conflict nexus, and sustainability: a governance role for a private multi-stakeholder regime like the RSPO? *The Pacific Review*, 26:505-526.

Reference ID: 22691

Notes: #22691e

Abstract: This paper examines the nexus between food security and sustainability governance through a case study of palm oil. Palm oil's advocates claim that campaigns against palm oil and actions to halt its expansion due to sustainability concerns can undermine its food security role. However, palm oil expansion more directly undermines the food and livelihood security of rural and indigenous communities when land that rightfully belongs to, or has been used by, these communities is alienated to firms for oil palm cultivation with little or no consultation or compensation provided or alternatives considered. It is in this context that the paper examines whether the multi-stakeholder Roundtable on Sustainable Palm Oil (RSPO) is able to ensure that this commodity is cultivated in ways that minimise environmental damage and livelihood disruption, thereby safeguarding palm oil's contribution to food security. The findings are mixed. RSPO certification provides fairly comprehensive and progressive socio-environmental regulation that has enhanced sustainable production practises in this industry especially by the larger transnational plantation companies mindful of their global reputation. The RSPO is also far more responsive than governments have been to the land rights of rural and indigenous communities, providing due process for land claimants as well as recognising that these communities may have legitimate rights to land even if companies were awarded legal title by governments. However, multi-stakeholder regimes can be fragile, requiring a great deal of internal accommodation and trade-offs to work. Already, different interests in the RSPO are pulling in different directions while national certification systems have emerged that are less onerous compared to the RSPO even as the

latter seeks to further enhance its sustainability credentials.

Malik U. S., M. Ahmed, M. A. Sombilla, and S. L. Cueno. 2009. Biofuels production for smallholder producers in the Greater Mekong Sub-region. *Applied Energy*, 86:S58-S68.

Reference ID: 22692

Notes: #22692e

Abstract: Looming concerns on rising food prices and food security has slowed down the impetus in biofuel production. The development of the sub-sector, however, remains an important agenda among developing countries like those of the Greater Mekong Sub-region (GMS) that have abundant labour and natural resources but have limited supply of fossil fuels which continues to serve as a constraint to economic growth. Five crops have been selected to be further developed and used for biofuel production in the GMS, namely sugarcane, cassava, oil palm, sweet sorghum and *Jathropa curcas*. The expanded use of sugarcane, cassava, and oil palm for biofuel production can cause problems in the food sector. The other two crops, sweet sorghum and *J. curcas*, are non-food crops but could still compete with the food crops in terms of resource use for production. In all cases, the GMS needs to formulate a sustainable strategy for the biofuel development that will not compete with the food sector but will rather help achieve energy security, promote rural development and protect the environment. Except for People's Republic of China (PRC) and Thailand that already have fairly developed biofuel sub-sector, the other GMS countries are either poised to start ((the) Lao People's Democratic Republic and Cambodia) or ready to enhance existing initiatives on biofuel production (Myanmar and Viet Nam), with support from their respective governments. Biofuel development in these countries has to be strongly integrated with smallholder producers in order to have an impact on improving livelihood. At this initial stage, the sub-sector does not need to compete on a price basis but should rather aim to put up small-scale biofuel processing plants in remote rural areas that can offer an alternative to high-priced diesel and kerosene for local electricity grids serving homes and small enterprises. The social and economic multiplier effects are expected to be high when farmers that produce the energy crops also produce the biofuels to generate affordable and reliable energy. To make this happen, there is a need for conscious effort and investment support from development agencies and the government working in partnership with the private sector, research institutions and the farmers.

Mendoza T. C. 2007. Are biofuels really beneficial for humanity? *Philippine Journal of Crop Science*, 32:85-100.

Reference ID: 22693

Notes: #22693e

Abstract: Biofuels are the single greatest threat to food security especially for the low-income groups in view of their influence on supply and prices of staple foods. The tipping point could be seen on their effect in propelling water scarcity into crisis proportion in 2 ways: a) feedstock production will use tremendous amounts of water, putting severe pressure on water allocation for food or for biofuel crop production, b) processing will produce voluminous liquid wastes, polluting both surface and ground waters, thus, reducing further the supply of clean and potable water. Biofuel production may further increase environmental degradation in the following ways: a) more land clearing/deforestation to grow the feedstock source which in turn may lead to more soil erosion due to tillage; b) drying of peat soils to grow more palm oil which will release more CO₂ in the atmosphere; c) the industrial plantation technology that will

be used in feedstock production will lead to greater use of fertilizers particularly nitrogen which will release more NO_x and CO₂, due to N-fertilizer manufacture, and greater use of oil in the various stages of feedstock production and processing; and d) as an agri-industrial production set-up, biofuel production thrives on large-scale monoculture plantation. This will trigger land concentration which will displace agrarian reform beneficiaries, thus reversing the gains of redistributive agrarian reform achievements of many Third World countries. Ironically, biofuel production does not contribute to energy security especially if corn and other energy intensive crops are used as feedstocks. Airing this difficult transition stage to more renewable, stable and environment-friendly energy alternatives, extra care and precautions are necessary to avoid falling into the trap of having a 'cure worst than the disease - the biofuel malady!' There are many other options to reduce oil consumption and they are as follows: improve energy efficiency, shift to organic agriculture, adopt vegetarian diet or less meat diet, adopt an ecological lifestyle, minimize the use of cars! - walk ride a bike, shift to more renewable and environment-friendly sources of energy like solar, wave, and wind energy.

Lam M. K., K. T. Tan, K. T. Lee, and A. R. Mohamed. 2009. Malaysian palm oil: Surviving the food versus fuel dispute for a sustainable future. *Renewable and Sustainable Energy Reviews*, 13:1456-1464.

Reference ID: 22694

Notes: #22694e

Abstract: For the past few decades, palm oil has gone through a revolution that few would have predicted. From a humble source of edible oil that was heavily criticized as being un-healthy and un-fit for human consumption, it has proven itself based on scientific findings that it is indeed one of the most nutritious edible oils in the world. Besides, palm oil, the cheapest vegetable oil in the market has diversified as one of the main feedstock for oleo-chemical industries. Recently, with the price of crude petroleum hitting records height every other day, palm oil has become one of the few feasible sources for biodiesel, a renewable substitute for petroleum-derived diesel. Nevertheless, the conversion of palm oil into biodiesel has again received criticism from various NGOs worldwide, mainly on extinction of orang utans, deforestation and particularly the food versus fuel dispute. It was claimed that the conversion of food crops to fuel would significantly increase the number of undernourished people in the world. Malaysia, being the world second largest producer of palm oil, is not spared from this criticism. On the contrary, in the present study it was found that palm oil is indeed the most economical and sustainable source of food and biofuel in the world market. Besides, it was shown that it has the capacity to fulfill both demands simultaneously rather than engaging in priority debate. Nevertheless, fuel is now a necessity rather than a luxury for economy and development purposes. A few strategies will then be presented on how palm oil can survive in this feud and emerged as the main supply of affordable and healthy source of edible oil while concurrently satisfying the market demand for biodiesel throughout the world.

Hridya A. C., G. Byju, and R. S. Misra. 2013. Effect of biocontrol agents and biofertilizers on root rot, yield, harvest index and nutrient uptake of cassava (*Manihot esculanta* Crantz). *Archives of Agronomy and Soil Science*, 59:1215-1227.

Reference ID: 22695

Notes: #22695e

Abstract: Cassava is an important subsidiary food and industrial raw material in the tropics. Root rot disease, caused by *Phytophthora palmivora*, poses a serious threat

to cassava cultivation in Tamil Nadu, India. Field experiments (2008-09) were conducted to study the effect of biocontrol agents (*Trichoderma* spp. and *Pseudomonas fluorescens*) and biofertilizers (*Azospirillum*, vesicular-arbuscular mycorrhizal fungi and phosphorus-solubilizing bacteria) on root rot, yield, harvest index and nutrient uptake of cassava at two NPK rates. The design of the experiment was a split plot with two NPK rates, recommended and 50% recommended rate, as the main plot treatments and five biocontrol agents and biofertilizers as subplot treatments. The results clearly indicated that use of a bioinoculants consortium significantly reduced root rot infection/disease incidence over uninoculated controls. *Azospirillum* significantly improved the yield of cassava at 50% of the recommended rate of NPK. NPK rates had no significant impact on harvest index of cassava and *Trichoderma* and vesicular-arbuscular mycorrhizal fungi resulted in a higher harvest index even at 50% of the recommended NPK rate. Nitrogen, phosphorus and potassium uptake was significantly improved when treated with biofertilizers and/or a consortium.

Kanto U., K. Jutamanee, Y. Osotsapar, and S. Jattupornpong. 2012. Effect Of Swine Manure Extract On Leaf Nitrogen Concentration, Chlorophyll Content, Total Potassium In Plant Parts And Starch Content In Fresh Tuber Yield Of Cassava. *Journal of Plant Nutrition*, 35:688-703.

Reference ID: 22696

Notes: #22696e

Abstract: The effects of swine manure extract (SME) as foliar fertilizer (FSME), soil fertilizer (SSME), and both soil and foliar fertilizer (FNSSME) on leaf nitrogen (N) concentration, chlorophyll content, total potassium (K) in plant parts and starch content in the fresh roots, compared to a conventional, chemical fertilizer (CF) were studied in cassava cultivar 'Hauybong 60'. The results showed that plants on FNSSME had the highest chlorophyll contents and SPAD values at four months after planting (MAP). Cassava plants treated with SSME and FNSSME had highest starch content and was significantly higher than in plants treated with CF and a FSME. There was a strong, positive relationship between the leaf nitrogen concentration and chlorophyll content in cassava at 6 MAP. The results of the study indicated that an application of FNSSME to cassava plants could provide a higher chlorophyll content and higher tuber quality of the plants than those applied with chemical fertilizer.

Byju G., M. Nedunchezhiyan, C. S. Ravindran, V. S. S. Mithra, V. Ravi, and S. K. Naskar. 2012. Modeling the Response of Cassava to Fertilizers: A Site-Specific Nutrient Management Approach for Greater Tuberous Root Yield. *Communications in Soil Science and Plant Analysis*, 43:1149-1162.

Reference ID: 22697

Notes: #22697e

Abstract: Conventional fertilizer-management strategy results in decreased fertilizer-use efficiency and unbalanced nitrogen (N)-phosphorus (P)-potassium (K) applications. The quantitative evaluation of fertility of tropical soils (QUEFTS) model was used for determining region-specific balanced NPK uptake requirements and recommendations for a target yield of cassava. Minimum and maximum internal efficiencies of N, P, and K were estimated as 35 and 80 for N, 250 and 750 for P, and 32 and 102 for K (kg tuberous root per kg nutrient removed). Linear increases in tuberous root yield with N, P, and K uptakes of 17.6, 2.2, and 15.6 kg N, P, and K per 1000 kg tuberous root yield were observed. Relationships between soil supply and soil chemical properties and between fertilizer nutrient recovery efficiencies with their rates

of application were developed for major cassava-production regions. Good agreement between measured and predicted yields was observed while calibrating the model, which shows that the model can be used for making site-specific NPK recommendations for cassava in major cassava production regions of India.

Zhiping Q., I. M. Rao, J. Ricaurte, E. Amezquita, J. I. Sanz, and P. C. Kerridge. 2004. Root distribution and nutrient uptake in crop-forage systems on Andean hillsides. *Journal of Sustainable Agriculture*, 23:39-50.

Reference ID: 22698

Notes: #22698e

Abstract: Root growth and distribution of crop and forage components of production systems on hillsides could have important effects on nutrient acquisition and plant growth, as well as on soil loss. A long-term field experiment was established in 1994 in the Andean hillsides region Ad of Cauca, Colombia. Soil at the site is medium- to fine-textured Andisol derived from volcanic-ash deposits. Four treatments-cassava monocrop, cassava + cover legumes intercrop, elephant grass forage, and imperial grass forage-were selected to determine differences in dry matter partitioning, leaf area index, nutrient composition, root distribution (0-80 cm soil depth), nutrient acquisition and soil loss. Root biomass of the cassava + cover legumes intercrop was 44% greater than that of the cassava monocrop. The presence of cover legumes not only reduced soil loss but also improved potassium acquisition by cassava. Among the two forage systems, elephant grass had greater root biomass (9.3 t/ha) than the imperial grass (4.2 t/ha). The greater root length density (per unit soil volume) of the former contributed to superior acquisition of nitrogen, phosphorus, potassium and calcium from soil. In addition, the abundance of very fine roots in the elephant grass forage system in the topsoil layers reduced the loss of soil from the steep slopes. These results indicate that (1) the presence of cover legumes can improve potassium acquisition by cassava; and (ii) the use of elephant grass as a forage grass can reduce soil loss in Andean hillsides.

Chavez A. L., J. M. Bedoya, T. Sanchez, C. Iglesias, H. Ceballos, and W. Roca. 2000. Iron, carotene, and ascorbic acid in cassava roots and leaves. *Food & Nutrition Bulletin*, 21:410-413.

Reference ID: 22699

Notes: #22699e

Abstract: The cassava core collection (601 genotypes) was evaluated for root and leaf contents of micronutrient minerals, ascorbic acid, and carotene. Wide genetic variability was observed for all measurements, indicating that there is good potential for exploiting and improving the nutritive value of cassava. There seems to be little correlation between the levels of any micronutrient in roots and leaves. There was no clear association between carotene and ascorbic acid concentrations. A genetic study of the progeny of a cross between yellow and white parents indicated control of the yellow trait by only two genes. The stability of vitamins after three commonly used processing procedures was evaluated in a sample of 26 genotypes. A higher proportion of the original vitamin content survived boiling, whereas solar drying resulted in the highest losses. Carotene was more stable than ascorbic acid. In a limited number of lines, there was some indication that higher vitamin content was associated with decreased post-harvest physiological deterioration. Since it is well established that β -carotene and ascorbic acid can enhance the absorption and internal transport of dietary iron and zinc from plant sources, yellow varieties of cassava have potential to address not only vitamin deficiencies per se, but also iron-deficiency

anaemia and zinc deficiency. Further, the use of the leaves as a vegetable, as is done in several African countries, can complement the use of the root as a staple because of the high nutrient density of the leaves. The potential to improve the nutritive potential of cassava is exciting.

Santos N., J. M. A. Alves, S. C. P. Uchoa, N. T. Oliveira, and J. Albuquerque. 2014. Absorption of macronutrients by cassava in different harvest dates and dosages of nitrogen: Absorção de macronutrientes pela mandioca em diferentes épocas de colheita e doses de nitrogênio. *Revista Ciencia Agronomica*, 45:633-640.

Reference ID: 22700

Notes: #22700e

Abstract: A field experiment was carried out in 2010-2011 crop years in the experimental area of the Centro de Ciências Agrárias of the Universidade Federal de Roraima, in Boa Vista, Roraima, Brazil. This study aimed to evaluate the effect of nitrogen availability on the concentrations of N, P, K, Ca, Mg and S in cassava, cultivar Aciolina, in different harvest times. A randomized block design was used in split-plot, with four replications. Dosages of N in cover were applied randomly on the plots (0, 30, 60, 150 and 330 kg ha⁻¹), and in the subplot the harvest dates 120, 150, 180, 210, 240, 270 and 300 days after emergence (DAE). The vegetal material was collected, ground and then underwent an analysis for determination of nutrients concentrations in the leaves (N, P, K, Ca Mg and S). The harvest dates and dosages of N affect the nutrient concentrations in the cassava leaves, cv. Aciolina. The macronutrients dosage in the leaves, 120 DAE, is a good indicator of the nutritional status of the cassava plant. The dosage of 150 kg ha⁻¹ of N raises the tubers roots per plant. The sequence of the macronutrients concentration in the leaves of the cassava, cv. Aciolina is N>Ca>K>Mg>P>S.

Abstract: Um experimento de campo foi conduzido entre os anos agrícolas de 2010 e 2011 na área experimental do Centro de Ciências Agrárias da Universidade Federal de Roraima em Boa Vista, Roraima, Brasil. Objetivou-se com este trabalho avaliar o efeito de doses de nitrogênio no teor de N, P, K, Ca, Mg e S na mandioca, cultivar Aciolina, em diferentes épocas de colheita. O delineamento experimental adotado foi em blocos casualizados em parcelas subdivididas, com quatro repetições. Nas parcelas foram aleatorizadas as doses de N em cobertura (0; 30; 60; 150 e 330 kg ha⁻¹) e nas subparcelas as épocas de avaliação 120; 150; 180; 210; 240; 270 e 300 dias após a emergência das plantas (DAE). O material vegetal coletado foi moído e, posteriormente, submetido à análise para obtenção dos teores de nutrientes nas folhas (N, P, K, Ca, Mg e S). As épocas de avaliação e as doses de N afetam os teores dos macronutrientes na folha da mandioca, cv. Aciolina. A dosagem dos macronutrientes na folha, aos 120 DAE, é um bom indicador do estado nutricional da planta de mandioca. A dose de 150 kg ha⁻¹ de N determina o maior rendimento de raiz por planta de mandioca. A concentração dos nutrientes na folha da mandioca, cv. Aciolina, é N>Ca>K>Mg>P>S.

Nguyen H., I. J. Schoenau, D. Nguyen, K. Van Rees, and M. Boehm. 2002. Effects of long-term nitrogen, phosphorus, and potassium fertilization on cassava yield and plant nutrient composition in North Vietnam. *Journal of Plant Nutrition*, 25:425-442.

Reference ID: 22701

Notes: #22701e

Abstract: The effects of repeated yearly fertilizer applications on cassava (*Manihot esculenta* Crantz.) yield and plant composition are not well documented in Vietnamese soils. In 1990, a research plot experiment was established on abandoned grassland

with 12 treatments to examine effects of different rates of nitrogen (N), phosphorus (P), and potassium (K) on cassava yield and tissue nutrient concentrations in Acrisols in North Vietnam. Cassava yield was measured every year over the period from 1990-1998. In June 1998, composite plant samples (leaf blades) were collected from each plot for nutrient analysis. Generally, cassava showed greater response to N in the latter years of the study due to gradual depletion of N fertility in the absence of N fertilization since cultivation. In plots where P fertilizer was added every year, response to added P fertilizer diminished over time due to accumulation of residue P. Yield responses to added K were large and consistent throughout the nine years of the study. Leaf blade N, K, and P concentrations increased with increasing rates of nutrient addition. The equation: $\log(\text{yield}) = -1.46 + 0.067(\text{leaf N}) + 0.225(\text{leaf P}) + 0.074(\text{leaf K}) - 0.046[\text{leaf magnesium (Mg)}]$ was determined to be effective in predicting cassava yield ($R^2 = 0.93$). Based on the results obtained, an N: P₂O₅: K₂O balance of 2 : 1 : 2 is recommended for cassava production on these soils.

Meijaard, E. Integrating business and conservation. The way forward or a slide into greenwashed oblivion? 2016.

Reference ID: 22702

Notes: #22702e (Slide presented at CBD-ATBC plenary June 2016)

Gaire A., S. Koirala, R. K. Shrestha, and L. P. Amgain. 2016. Growth and Productivity of Different Cultivars of Rice under Nutrient Expert® and Other Fertilizer Management Practices at Lamjung. International Journal of Applied Science and Biotechnology, 4:178-182.

Reference ID: 22703

Notes: #22703e

Abstract: Rice is an important world leading cereal crop grown extensively in tropical and sub-tropical regions of the world. However, its productivity is constrained by a number of problems. Currently, cereal yields are only 40 to 65% of their potential, mostly because nutrient management does not consider crop's dynamic response to the environment and site specific nutrition management. Therefore, a field experiment was conducted on farmer's field at Lamjung, Sundarbazar and Bhoteodar using Nutrient Expert® rice model from July 2015 to November 2015. Four replications of 5 treatments were arranged in randomized complete block design. Five treatments were Nutrient Expert recommendation (NE hybrid), Government recommendation (GR hybrid), NE improved, GR improved and Farmers field practice (FFP). The result revealed significant difference in terms of plant height, panicle weight, filled grain/panicle, straw yield, grain yield at 15.5% moisture, biological yield and sterility %. The highest yield (7.362tonha⁻¹) was obtained from NE hybrid field which was followed by GR hybrid (6.12tonha⁻¹), NE improved (5.20tonha⁻¹), FFP (4.76tonha⁻¹) and GR improved (4.70tonha⁻¹). While comparing Nutrient Expert® (NE) estimation for attainable rice yield with actual rice yield from the farmer field trial; NE-based fertilizer recommendations proved to be successful in reaching the yield targets estimated by the software. The actual rice yields recorded in farmer fields were higher than the NE estimated attainable yields, so NE recommendation was found better over GR and FFP.

Wilcove D. S. and L. P. Koh. 2010. Addressing the threats to biodiversity from oil-palm agriculture. Biodiversity and Conservation, 19:999-1007.

Reference ID: 22704

Notes: #22704e

Abstract: Oil-palm agriculture is the greatest immediate threat to biodiversity in Southeast Asia. Despite the efforts of environmentalists, oil palm continues to expand across the tropics. Those concerned about the impacts of oil palm on biodiversity must face some harsh social, economic, and ecological realities: (i) oil palm has been a very profitable crop; (ii) palm oil is used in so many products that simple, direct actions, such as boycotts, are unlikely to succeed; (iii) there is currently insufficient demand for certified sustainable palm oil and inadequate political clout from environmental groups in two of the biggest markets for palm oil—China and India—to slow the rate of forest conversion; and (iv) oil-palm agriculture has improved the lives of poor rural communities in Southeast Asia (although it has also disenfranchised some indigenous communities). To address the threats posed by oil-palm agriculture to biodiversity, environmentalists must change the behavior of the palm oil business through: (i) regulations to curb undesirable activities (e.g., a ban on converting forests to oil palm); (ii) financial incentives to promote desirable behavior (e.g., production of certified, sustainable oil palm); (iii) financial disincentives designed to discourage undesirable behavior (e.g., consumer pressure on major manufacturers and retailers to use palm oil that does not come from plantations created at the expense of forests); and (iv) the promotion of alternative, more biodiversity-friendly uses of forested land that might otherwise be converted to oil palm. There is no single best approach for dealing with the oil-palm crisis in Southeast Asia; a mixture of regulations, incentives, and disincentives targeted at all sectors of the oil-palm industry is necessary to protect the region's rapidly disappearing forests.

Monselise S. P. and E. E. Goldschmidt. 2011. Alternate Bearing in Fruit Trees. Pages 128-173 Horticultural Reviews Vol 4.

Reference ID: 22705

Notes: #22705e

Abstract: Problems of alternate (or biennial) bearing in fruit trees have been investigated and reviewed on many occasions in the last decades. Only review papers with extensive bibliographic lists will be quoted here (Singh 1949; Davis 1957; Singh 1971; Williams and Edgerton 1974; Jonkers 1979). Most of these reviews deal mainly with one sort of tree. Alternation is, however, a very widely spread phenomenon, occurring in both deciduous and evergreen trees.

Runting, R. K., Meijaard, E., Abram, N. K., Wells, J. A., Gaveau, D. L. A., Ancrenaz, M., Possingham, H. P., Wich, S. A., Ardiansyah, F., Gurnal, M. T., Ambu, L. N., and Wilson, K. A. Alternative futures for Borneo show the value of integrating economic and conservation targets across borders. *Nature Communications*, 1-11. 2015.

Reference ID: 22706

Notes: #22706e

Abstract: Balancing economic development with international commitments to protect biodiversity is a global challenge. Achieving this balance requires an understanding of the possible consequences of alternative future scenarios for a range of stakeholders. We employ an integrated economic and environmental planning approach to evaluate four alternative futures for the mega-diverse island of Borneo. We show what could be achieved if the three national jurisdictions of Borneo coordinate efforts to achieve their public policy targets and allow a partial reallocation of planned land uses. We reveal the potential for Borneo to simultaneously retain B50% of its land as forests, protect adequate habitat for the Bornean orangutan (*Pongo pygmaeus*) and Bornean elephant (*Elephas maximus borneensis*), and achieve an opportunity cost saving of over US\$43 billion. Such coordination would depend on enhanced information sharing and reforms

to land-use planning, which could be supported by the increasingly international nature of economies and conservation efforts.

Ling A. H. 1984. Cocoa nutrition and manuring on inland soils in Peninsular Malaysia. *The Planter*, 60:12-24.

Reference ID: 22707

Notes: #22707e (note hard copy is in *The Planter* January 1984)

Abstract: This paper reviews the research carried out to date by Dunlop Estates Berhad on the nutrition of cocoa on inland soils of Peninsular Malaysia. Studies reviewed include destructive analysis of whole cocoa plants, pod analysis, litter production and nutrient recycling, and fertiliser trials.

On inland soils of inherently low fertility applications to cocoa are essential for rapid growth and sustained high yields. N, P, K and Ca are found to be important for rapid establishment and early production of cocoa. In matured cocoa, the requirements for K appear to decline, especially when recycling of pod husks are practised. As for N, the needs depend greatly on the environmental situation with rainfall and shade being the main determining factors. There are strong indications that P is continuously required for sustained growth and yield of mature cocoa. The requirement for Mg has not been fully established.

An interim integrated approach towards manuring of cocoa on inland soils is proposed. The approach takes into consideration factors such as soil type, nutrient uptake in relation to tree age, leaf nutrient level, yield level, type and level of shade and other related agronomic factors.

Chung G. F., C. T. Lee, and K. H. Chee 2016. *Pictorial Guide to Oil Palm Cultivation and Mammalian Pests (including their management)*, ACT (Agricultural Crop Trust), Selangor.

Reference ID: 22708

Notes: S 8.1.1.4 #22708

Abstract: Oil palm is the main plantation tree crop of Malaysian and Indonesian agriculture. In 2015, Indonesia the world largest oil palm country has over 9 million hectares and Malaysia coming in second with over 5 million hectares. The increasing world population will need more food, which can only be met by increasing crop yields. With an area over 15 million hectares of global oil palm, the industry employs 2 million people directly. In Malaysia alone, oil palm provides a livelihood for over a million people - including 300000 small farmers. The effective and efficient science based management in oil palm cultivation including the successful management of mammalian pests is very important to ensure healthy palm growth at all stages and to maximize crop yield by achieving high oil yield per ha.

Baskett J. P. 2016. *Myanmar Oil Palm Plantations: A productivity & sustainability review*, Fauna & Flora International.

Reference ID: 22709

Notes: S 8.1.1 #22709e

Abstract: The productivity and the sustainability, as defined in the Roundtable on Sustainable Palm Oil Principles and Criteria (RSPO P&C), 1 of oil palm plantations in the Tanintharyi Region of southern Myanmar were assessed during three site visits by the author, the French Agricultural Research Centre for International Development (CIRAD), and Fauna & Flora International (FFI). In total, 12 plantations were visited. Plantations varied greatly in size, productivity, and in standards of sustainable production.

It is assessed that although climatic conditions in the region (4-5 months annual drought and 4-5 months very heavy rainfall) are not ideal for maximising the crop yield potential of this cultivar, some very reasonable yields are being obtained from early plantings established on flat to undulating terrain with good soils along the coastal belt, and that with enhanced input a productive industry can be sustained. However there are many aspects of the plantation establishment, management and operation in this Region that preclude efficient production of sustainable palm oil and optimisation of oil palm crop yields. The aspects of greatest importance are:

- Government policies on allotment of land for extension plantings without adequate land use planning that ensure undue deforestation, adverse social and environmental conditions, and also planting on unsuitable soils and steep hill slopes to the detriment of future crop yields and economic returns.
- In general, but with a few exceptions, the plantations are poorly managed. Management strategies do not appear to focus on crop optimisation, primarily due to poor staff/worker policies and lack of training, and also to poor agronomic practices. Fruit processing facilities on some of the plantations are woefully inadequate resulting in high production losses.
- The shortage of funding from head offices is often cited as the reason for the problems experienced at plantation level.
- There is a need for improved research facilities and agronomic advisory visits to plantations. In particular, research trials should be established to determine the most appropriate genetic materials and fertilisers to use under the local conditions.
- Further consideration should be given to the expansion of oil palm smallholder schemes, especially for local populations.
- Greater consideration should also be given by the government, the plantation owners, and plantation managements to instituting national sustainability guidelines, as promoted internationally by the RSPO that would be rigorously implemented by the industry.

Insufficient data was given to the visitors to provide an accurate economic assessment of the industry and its component operations. However, it is an economic fact that by increasing the production of oil per unit area, there should be a corresponding offset of the amount of land required to fulfil production targets. Stringent forward planning is required of all parties to ensure that only the most appropriate land with the greatest potential for high and sustainable palm oil yields is selected for future development.

C & CI. C&CI: Coffee and Cocoa International July 2016. Foxwell, D. editor. [43], 1-50. 2016. UK, Kingsley, A.P.

Reference ID: 22710

Notes: S serial #22710

Anonymous 1934. Der Kakaobaum: Theobroma Cacao L.

Reference ID: 22711

Notes: S 8.1.4 #22711 (in german)

This book has been repaired and some pages missing. From google translate:

Cook S. E. and R. J. Corner. 1996. Precision Agriculture and Risk Analysis: An Australian Example. Pages 1123-1132 American Society of Agronomy (ASA), Crop Science Society of America (CSSA), Soil Science Society of America (SSSA), Wisconsin.

Reference ID: 22712

Notes: #22712e > S 11.4 #14747

Abstract: A potential benefit of precision agriculture is the capability it gives us to analyse the risk of change. We illustrate how GIS-based modeling of expected outcomes from alternative fertilizer plans can be used to identify the comparative risks associated with each. The major source of uncertainty in our example appeared to be climatic variation, which increased the risk of variable rate application relative to its benefits.

C & CI. C&CI: Coffee and Cocoa International March 2016. [43], 1-50. 2016.

Reference ID: 22713

Notes: S serial #22713

C & CI. C&CI: Coffee and Cocoa International May 2016. [43], 1-50. 2016.

Reference ID: 22714

Notes: S serial #22714

ISP. The Planter Vol 92 No 1079 February 2016. [92], 57-114. 2016. Kuala Lumpur, ISP.

Reference ID: 22715

Notes: S serial #22715

Abstract:

Editorial: Now: False Allegations against Natural Rubber Cultivation
Technical: Preliminary Investigations on the Infestation of Swamp Giant Rat, *Sundamys muelleri* (Jentink), Muridae, Rodentia in an Oil Palm Estate, Miri, Sarawak
#22717

Reproduced: The Population and Demography Dimension: an 'Elephant in the Room'?
#22718

ISP. The Planter Vol 92 No 1080 March 2016. [92], 123-188. 2016. Kuala Lumpur, ISP.

Reference ID: 22716

Notes: S serial #22716

Abstract:

Editorial: Is it Human Resource, Human Capital or Talent Management? - Make a Choice...but Change or be Ordinary
Technical: Responsible Development of New Oil Palm Plantings - RSPO's Approach
#22719

An Ecological Study on a Noxious Weed, *Parthenium hysterophorus* L and Its Management in Malaysia in 2015 **#22720**

Chung G. F. 2016. Preliminary Investigations on the Infestation of Swamp Giant Rat, *Sundamys muelleri* (Jentink), Muridae, Rodentia in an Oil Palm Estate, Miri, Sarawak. The Planter, 92:65-84.

Reference ID: 22717

Notes: #22717 > S serial #22715

Abstract: Severe rat damage was reported in an oil palm estate on peat soil near Miri, Sarawak. Fruit bunches and post-anthesis male inflorescence (PAMI) in mature plantings were attacked by rats. The main rat species was identified as *Sundamys muelleri* from many rats provided by the estate and rats found during the present investigation [hunting, trapping in catch-mark-release (CMR) study]. Two other rats killed during hunting were identified as *Rattus tiomanicus*. In short two day period, the preliminary investigations (including training of young agronomists) covered hunting, CMR study, damage assessment, and bait acceptance study.

Abdullah M. 2016. The Population and Demography Dimension: an 'Elephant in the Room'? *The Planter*, 92:85-93.

Reference ID: 22718

Notes: #22718 > S serial #22715

(Reproduced from Agriculture for Development, Summer 2015)

Abstract: My contribution to this TAA seminar arises out of some earlier meetings. In April 2012, we debated the population food equation, including a paper on Population limits (wood, 2012). This was in part a follow up to a UK government sponsored meeting (Foresight, 2011). Then in March 2014, the branch held a seminar on Technology and/or Ecology, with an interesting exposition of environmental issues by Alastair McIntosh. I commented that the population explosion was "the elephant in the room". That meeting was inclined to concentrate on the technical aspects, but when today's topic was announced, it seemed to me that over-population was a key aspect of Agriculture and conflict, and that this merited further airing. My use of the elephant phrase was noted by TAA SW Chairman, John Wibberley, who suggested the present title. An elephant in the room, presumably, is something very large and potentially intrusive, but that becomes too familiar to be noticed.

Kumaran S. and S. Yaacob. 2016. Responsible Development of New Oil Palm Plantings - RSPO's Approach. *The Planter*, 92:131-152.

Reference ID: 22719

Notes: #22719 > S serial #22716

Abstract: The Roundtable on Sustainable Palm Oil (RSPO) was established in 2004 to promote the production and use of sustainable palm oil for people, planet and prosperity. The RSPO is a non-profit multi-stakeholder initiative which has a vision to "transform the markets to make sustainable palm oil the norm" and has a mammoth task ahead to materialise this vision. This paper provides information on the RSPO New Planting Procedure and compares it with feasibility studies carried out by growers and investors.

Ng K. Y. 2016. An Ecological Study on a Noxious Weed, *Parthenium hysterophorus* L. and Its Management in Malaysia in 2015. *The Planter*, 92:153-167.

Reference ID: 22720

Notes: #22720 > S serial #22716

Abstract: *Parthenium hysterophorus* L., commonly known as Parthenium weed is an invasive weed and was first reported in Malaysia in 2013. This alien weed is now found in many parts of the country but it has not been recorded in Kelantan, Terengganu and Pahang in Peninsular Malaysia and Sarawak in East Malaysia. The plant also produces chemical compounds of parthenin and other phenolic acids in all parts of the plant, including hair-like structure (trichomes) on the stems and leaves and pollens, that are highly toxic to human and animals. In tropical Malaysia, the natural vegetation

grows well and has been observed to suppress and contained the spread of parthenium weed.

Jadán O., M. Cifuentes, B. Torres, D. Selesi, D. Veintimilla, and S. Günter. 2015. Influence of tree cover on diversity, carbon sequestration and productivity of cocoa systems in the Ecuadorian Amazon. *Bois et forêts des tropiques*, 325:35-47.

Reference ID: 22721

Notes: #22721e

Abstract: Cocoa production in the Ecuadorian Amazon is an important source of income for the local population. There is a wide variety of cocoa production systems, from enriched primary forests to traditional agroforestry systems and monoculture. This study assesses the relationship between tree diversity, carbon stocks, agricultural productivity and forest use potential under three land use systems in the Ecuadorian Amazon: cocoa-based agroforestry (Cocoa AFS), cocoa monoculture (Monoculture) and primary forest (PF). Understanding and quantifying the tradeoffs between different ecosystem services related to cocoa production systems can contribute to the conservation of primary forests and help to optimize income for local people. Species richness, beta-diversity, carbon stocks (above- and below-ground biomass, necromass and soil), and cocoa and timber production were determined for each system in 1,600 m² study plots (n=28). The results show that beta diversity, species richness and carbon stocks were significantly higher in PF and Cocoa AFS, whereas cocoa production was 1.5 times higher in the Monoculture than in Cocoa AFS. In both cocoa systems, species richness, beta diversity and total C were negatively correlated with cocoa productivity. Although our results show that cocoa monoculture was more profitable than Cocoa AFS for the farmers, a monetary payment based on carbon credits for avoided deforestation could be a viable strategy to support the implementation of Cocoa AFS, which would help conservation efforts and climate change mitigation while sustaining commercial cocoa production in the area.

Becker J., H. Pabst, J. Mnyonga, and Y. Kuzyakov. 2015. Annual litterfall dynamics and nutrient deposition depending on elevation and land use at Mt. Kilimanjaro. *Biogeosciences*, 12:5635-5646.

Reference ID: 22722

Notes: #22722e

Abstract: Litterfall is one of the major pathways connecting above- and below-ground processes. The effects of climate and land-use change on carbon (C) and nutrient inputs by litterfall are poorly known. We quantified and analyzed annual patterns of C and nutrient deposition via litterfall in natural forests and agroforestry systems along the unique elevation gradient of Mt. Kilimanjaro.

Tree litter in three natural (lower montane, *Ocotea* and *Podocarpus* forests), two sustainably used (homegardens) and one intensively managed (shaded coffee plantation) ecosystems was collected on a biweekly basis from May 2012 to July 2013. Leaves, branches and remaining residues were separated and analyzed for C and nutrient contents.

The annual pattern of litterfall was closely related to rainfall seasonality, exhibiting a large peak towards the end of the dry season (August-October). This peak decreased at higher elevations with decreasing rainfall seasonality. Macronutrients (N, P, K) in leaf litter increased at mid elevation (2100 m a.s.l.) and with land-use intensity. Carbon content and micronutrients (Al, Fe, Mn, Na) however, were unaffected or decreased with land-use intensity.

While leaf litterfall decreased with elevation, total annual input was independent of climate. Compared to natural forests, the nutrient cycles in agroforestry ecosystems were accelerated by fertilization and the associated changes in dominant tree species.

de Bruyn M., B. Stelbrink, R. J. Morley, R. Hall, G. R. Carvalho, C. H. Cannon, G. van den Bergh, E. Meijaard, I. Metcalfe, L. Boitani, L. Maiorano, R. Shoup, and T. von Rintelen. 2014. Borneo and Indochina are Major Evolutionary Hotspots for Southeast Asian Biodiversity. *Systemic Biology*, 63:879-901.

Reference ID: 22723

Notes: #22723e

Abstract: Tropical Southeast (SE) Asia harbors extraordinary species richness and in its entirety comprises four of the Earth's 34 biodiversity hotspots. Here, we examine the assembly of the SE Asian biota through time and space. We conduct meta-analyses of geological, climatic, and biological (including 61 phylogenetic) data sets to test which areas have been the sources of long-term biological diversity in SE Asia, particularly in the pre-Miocene, Miocene, and Plio-Pleistocene, and whether the respective biota have been dominated by *in situ* diversification, immigration and/or emigration, or equilibrium dynamics. We identify Borneo and Indochina, in particular, as major "evolutionary hotspots" for a diverse range of fauna and flora. Although most of the region's biodiversity is a result of both the accumulation of immigrants and *in situ* diversification, within-area diversification and subsequent emigration have been the predominant signals characterizing Indochina and Borneo's biota since at least the early Miocene. In contrast, colonization events are comparatively rare from younger volcanically active emergent islands such as Java, which show increased levels of immigration events. Few dispersal events were observed across the major biogeographic barrier of Wallace's Line. Accelerated efforts to conserve Borneo's flora and fauna in particular, currently housing the highest levels of SE Asian plant and mammal species richness, are critically required.

Chavez E., Z. L. He, P. J. Stoffella, R. S. Mylavarapu, Y. C. Li, B. Moyano, and V. C. Baligar. 2015. Concentration of cadmium in cacao beans and its relationship with soil cadmium in southern Ecuador. *Science of the Total Environment*, 533:205-214.

Reference ID: 22724

Notes: #22724e

Abstract: Cadmium (Cd) content in cacao beans above a critical level (0.6 mg kg⁻¹) has raised concerns in the consumption of cacao-based chocolate. Little is available regarding Cd concentration in soil and cacao in Ecuador. The aim of this study was to determine the status of Cd in both, soils and cacao plants, in southern Ecuador. Soil samples were collected from 19 farms at 0-5, 5-15, 15-30, and 30-50 cm depths, whereas plant samples were taken from four nearby trees. Total recoverable and extractable Cd were measured at the different soil depths. Total recoverable Cd ranged from 0.88 to 2.45 and 0.06 to 2.59, averaged 1.54 and 0.85 mg kg⁻¹, respectively in the surface and subsurface soils whereas the corresponding values for M3-extractable Cd were 0.08 to 1.27 and 0.02 to 0.33 with mean values of 0.40 and 0.10 mg kg⁻¹. Surface soil in all sampling sites had total recoverable Cd above the USEPA critical level for agricultural soils (0.43 mg kg⁻¹), indicating that Cd pollution occurs. Since both total recoverable and M3-extractable Cd significantly decreased depth wise, anthropogenic activities are more likely the source of contamination. Cadmium in cacao tissues decreased in the order of beans N shell > N leaves. Cadmium content in cacao beans ranged from 0.02 to 3.00, averaged 0.94 mg kg⁻¹, and 12 out of 19 sites had bean Cd content above the critical level. Bean Cd

concentration was highly correlated with M3- or HCl-extractable Cd at both the 0-5 and 5-15 cm depths ($r=0.80$ and 0.82 for M3, and $r=0.78$ and 0.82 for HCl; $P < 0.01$). These results indicate that accumulation of Cd in surface layers results in excessive Cd in cacao beans and M3- or HCl extractable Cd are suitable methods for predicting available Cd in the studied soils.

ECA, CAOBISCO, and FCC 2015. Cocoa Beans: Chocolate & Cocoa Industry Quality Requirements, ECA-Caobisco-FCC Cocoa Research Fund.

Reference ID: 22725

Notes: #22725e

Abstract: Global Cocoa Agenda Actions: "Improve cocoa quality by better communication of industry needs, post-harvest processing and quality assessment." The European Cocoa Industry needs a sustainable and consistent supply of cocoa beans with the quality attributes to meet our diverse requirements. Various types of cocoa beans are needed to meet the demands of a complex market for chocolate and cocoa-derived products in which food safety, efficiency and cost effectiveness are key factors alongside consumer demands for taste and quality. We all need cocoa beans which will allow us to produce products that are wholesome and comply with European legislation and other international food safety standards. As the source of unique cocoa flavour and nutritional components, the importance of a consistently high standard of quality in cocoa beans cannot be over emphasised. Chocolate sells in a very competitive market, where quality and value are paramount. If the quality of the cocoa beans is poor, final products suffer and the industry as a whole loses as consumers turn to other snack foods. As set out in the Global Cocoa Agenda² which has been internationally agreed as the road map to achieve a sustainable world cocoa economy, there is a need to "improve cocoa quality by better communication of industry needs, post-harvest processing and quality assessment"; and to "enhance food safety by wider promotion and adoption of Good Agricultural Practices...". This publication aims to provide a comprehensive, up-to-date reference document which brings together the key information from a range of publications covering aspects of cocoa farming practices, food safety and quality and provides linkages to sources of further details.

This publication "Cocoa Beans: Chocolate and Cocoa Industry Requirements" is based on The UK Biscuit, Cake, Chocolate and Confectionery Alliance (BCCCA) publication "Cocoa Beans- Chocolate Manufacturers".

Curry G. N., G. Koczberski, J. Lummani, R. Nailina, E. Peter, G. McNally, and O. Kuaimba. 2015. A bridge too far? The influence of socio-cultural values on the adaptation responses of smallholders to a devastating pest outbreak in cocoa. *Global Environmental Change*, 35:1-11.

Reference ID: 22726

Notes: #22726e

Abstract: The influence of socio-cultural factors on the adaptive capacity, resilience and trade-offs in decision-making of households and communities is receiving growing scholarly attention. In many partly transformed societies, where the market economy is not well developed, livelihood practices are heavily structured by kinship and indigenous social and economic values. Farm investment decisions and incentives to produce agricultural commodities are shaped by a host of considerations in addition to market imperatives like profit. In one such partly transformed society in East New Britain Province, Papua New Guinea, we examine the adaptation decisions of smallholders in response to the drastic drop of yield in their cocoa plots caused by the

sudden outbreak of Cocoa Pod Borer. To explain why the impact of the pest has been so great we examine the interconnections between household responses, the local socio-cultural and economic context of smallholder commodity crop production and the wider institutional environment in which household choices and decisions are made. We argue that the significant lifestyle changes and labour intensive farming methods required for the effective control of Cocoa Pod Borer are incompatible with existing smallholder farming systems, values and livelihoods. To adopt a high input cropping system requires more than a technical fix and some training; it also requires abandoning a 'way of life' that provides status, identity and a moral order, and which is therefore highly resistant to change. The paper highlights the enduring influence and significance of local, culturally-specific beliefs and socio-economic values and their influence on how individuals and communities make adaptation decisions.

UNEP. 2011. Oil palm plantations: threats and opportunities for tropical ecosystems. UNEP Global Environment Alert Service (GEAS), Dec 2011:1-8.

Reference ID: 22727

Notes: #22727e

Abstract: An international commodity used for food, household and industrial purposes, oil palm is cultivated on approximately 15 million ha worldwide. As global demand for palm oil is expected to double by 2020, researchers have broadly studied the varying environmental threats arising from increased oil palm production.

Fountas S., G. Carli, C. G. Sørensen, Z. Tsiropoulos, C. Cavalari, A. Vatsanidou, B. Liakos, M. Canavari, J. Wiebensohn, and B. Tisserye. 2015. Farm management information systems: Current situation and future perspectives. *Computers and Electronics in Agriculture*, 115:40-50.

Reference ID: 22728

Notes: #22728e

Abstract: Farm Management Information Systems (FMIS) in agriculture have evolved from simple farm recordkeeping into sophisticated and complex systems to support production management. The purpose of current FMIS is to meet the increased demands to reduce production costs, comply with agricultural standards, and maintain high product quality and safety. This paper presents current advancements in the functionality of academic and commercial FMIS. The study focuses on open-field crop production and centers on farm managers as the primary users and decision makers. Core system architectures and application domains, adoption and profitability, and FMIS solutions for precision agriculture as the most information-intensive application area were analyzed. Our review of commercial solutions involved the analysis of 141 international software packages, categorized into 11 functions. Cluster analysis was used to group current commercial FMIS as well as examine possible avenues for further development. Academic FMIS involved more sophisticated systems covering compliance to standards applications, automated data capture as well as interoperability between different software packages. Conversely, commercial FMIS applications targeted everyday farm office tasks related to budgeting and finance, such as recordkeeping, machinery management, and documentation, with emerging trends showing new functions related to traceability, quality assurance and sales.

Gaveau D. L. A., S. Sloan, E. Molidena, H. Yaen, D. Sheil, N. K. Abram, M. Ancrenaz, R. Nasi, M. Quinones, N. Wielaard, and E. Meijaard. 2014. Four Decades of Forest Persistence, Clearance and Logging on Borneo. *Plos One*, 1-11.

Reference ID: 22729

Notes: #22729e

Abstract: The native forests of Borneo have been impacted by selective logging, fire, and conversion to plantations at unprecedented scales since industrial-scale extractive industries began in the early 1970s. There is no island-wide documentation of forest clearance or logging since the 1970s. This creates an information gap for conservation planning, especially with regard to selectively logged forests that maintain high conservation potential. Analysing LANDSAT images, we estimate that 75.7% (558,060 km²) of Borneo's area (737,188 km²) was forested around 1973. Based upon a forest cover map for 2010 derived using ALOS-PALSAR and visually reviewing LANDSAT images, we estimate that the 1973 forest area had declined by 168,493 km² (30.2%) in 2010. The highest losses were recorded in Sabah and Kalimantan with 39.5% and 30.7% of their total forest area in 1973 becoming non-forest in 2010, and the lowest in Brunei and Sarawak (8.4%, and 23.1%). We estimate that the combined area planted in industrial oil palm and timber plantations in 2010 was 75,480 km², representing 10% of Borneo. We mapped 271,819 km of primary logging roads that were created between 1973 and 2010. The greatest density of logging roads was found in Sarawak, at 0.89 km km², and the lowest density in Brunei, at 0.18 km km². Analyzing MODIS-based tree cover maps, we estimate that logging operated within 700 m of primary logging roads. Using this distance, we estimate that 266,257 km² of 1973 forest cover has been logged. With 389,566 km² (52.8%) of the island remaining forested, of which 209,649 km² remains intact. There is still hope for biodiversity conservation in Borneo. Protecting logged forests from fire and conversion to plantations is an urgent priority for reducing rates of deforestation in Borneo.

Jadin, I., Meyfroidt, P., and Lambin, E. F. International trade, and land use intensification and spatial reorganization explain Costa Rica's forest transition. *Environmental Research Letters* 11, 1-14. 2016.

Reference ID: 22730

Notes: #22730e

Abstract: While tropical deforestation remains widespread, some countries experienced a forest transition—a shift from net deforestation to net reforestation. Costa Rica had one of the highest deforestation rates in the 1980s and is now considered as a model of environmental sustainability, despite being a major producer of bananas and pineapples. We tested three land use processes that are thought to facilitate forest transitions. First, forest transitions may be accompanied by land use displacement through international trade of land-based products, which may undermine the global-scale environmental benefits of national forest protection. Second, reforestation is often associated with land use intensification in agriculture and forestry, allowing for land sparing. Third, this intensification may partly result from a geographical redistribution of land use at the sub-national scale to better match land use with land suitability. These hypotheses were verified for Costa Rica's forest transition. We also tested whether forest increased mainly in regions with a low ecological value and agriculture expanded in regions with a high ecological value. Intensification and land use redistribution accounted for 76% of land spared during the forest transition, with 32% of this spared area corresponding to net reforestation. Decreasing meat exports led to a contraction of pastures, freeing an area equivalent

to 80% of the reforested area. The forest transition in Costa Rica was environmentally beneficial at the global scale, with the reforested area over 1989–2013 corresponding to 130% of the land use displaced abroad through imports of agricultural products. However, expansion of export-oriented cropland caused deforestation in the most ecologically valuable regions of Costa Rica. Moreover, wood extraction from forest plantations increased to produce the pallets needed to export fruits. This highlights the importance of a multi-scale analysis when evaluating causes and impacts of national-scale forest transitions.

Kayode C. O., O. E. Ayanfe Olunwa, A. F. Adekunle, D. O. Ogunleti, and D. T. Ezekiel-Adewoyin. 2014. Nutrient Release Pattern of Cocoa Pod Husk Based Composts in an Incubation Study. *International Journal of Plant & Soil Science*, 4:513-520.

Reference ID: 22731

Notes: #22731e

Abstract: In order to apply compost to fulfill the nutrient requirements of a crop, knowledge of the amount of nutrients mineralized following application is needed. The objective of this study was to compare the effect of different cocoa pod husk based composts on soil nutrient status as well as the pH. The experimental design was 4 x 2 x 5 factorial laid in a completely randomized design replicated three times. The factors were four compost types; Cocoa Pod Husk + Poultry Manure + Neem leaves (CPH + PM + NL), Cocoa Pod Husk + Poultry manure (CPH + PM), Cocoa Pod Husk + Neem leaves (CPH + NL) and No compost (Control), two soil types; Ibadan (Alfisol) and Ikenne (Ultisol) and five incubation periods; 2, 4, 6, 8 and 10 weeks. Each compost was applied separately at the rate of 10 tons ha⁻¹. Routine analysis of the soil before incubation indicated that the two soil types had low nutrient status. The composts significantly ($p < 0.05$) influenced the soil nutrient status after incubation. Correlation of nutrient release with time by composts showed that there was no correlation between the time of incubation and nutrient release from all the composts except in the case of CPH + PM that had significant relationship with the release of N. The result showed that the N release from CPH+PM decreases with time of incubation. The pH of the soils treated with different composts was significantly increased compared with control.

Potter L. 2015. *Managing Oil Palm Landscapes: A seven-country survey of the modern palm oil industry in Southeast Asia, Latin America and West Africa*, Center for International Forestry Research (CIFOR), Bogor, Indonesia.

Reference ID: 22732

Notes: #22732e CIFOR Occasional Paper no 122

Abstract: This study comprises a review of oil palm development and management across landscapes in the tropics. Seven countries have been selected for detailed analysis using surveys of the current literature, mainly spanning the last fifteen years. Indonesia and Malaysia are the obvious leaders in terms of area planted and levels of production and export, but also in literature generated on social and environmental challenges. In Latin America, Colombia is the dominant producer with oil palm expanding in disparate landscapes with a strong focus on palm oil-based biodiesel; and small-scale growers and companies in Peru and Brazil offer contrasting ways of inserting oil palm into the Amazon. Nigeria and Cameroon represent African nations with traditional groves and old plantations in which foreign land grabs to establish new oil palm have recently occurred.

The literature surveys have been conducted in English and complemented with literature in local languages (Indonesian, Spanish, Portuguese and French), and

where possible have also included fieldwork. Four major themes are used to structure the argument and maintain a comparative approach. They are: 1) the influence of oil palm expansion in economic development and land use change, especially deforestation; 2) the role of government policies and corporate strategies in shaping oil palm development; 3) the business models commonly used, especially plantations and various types of smallholders, either assisted or independent; and 4) ongoing initiatives towards more sustainable and inclusive oil palm production. This study shows that oil palm development is heavily entrenched in local and national political economies and responses for advancing towards more sustainable oil palm have to look beyond oil palm as a sector and a commodity.

McCown R. L. 2012. A cognitive systems framework to inform delivery of analytic support for farmers' intuitive management under seasonal climatic variability. *Agricultural Systems*, 105:7-20.

Reference ID: 22733

Notes: #22733e

Abstract: The idea of the decision support system (DSS) for farmers remains an enigma. Clever technology to bridge the gap between agricultural science and farming practice still seems appropriate. Many more of the conditions for success appear to exist today than ever before. Yet the DSS has yet to significantly colonise farm decision making practice. This paper comes late in a long program of research conducted to see if, and under what conditions, computer simulation of farming scenarios, on which a DSS generally depends, can be valued by farmers.

The research approach used an unconventional prototypic information system (IS), comprising local measurements, models, and facilitated discussions that evolved in an action research program. The aim has been to elucidate the means by which successful simulation-based decision support intervention can take place and why it usually does not. This required a significant expansion of the researchers' concept of the farm as a system to include the farmer's internal system of practical knowing and learning. This paper reports on a cognitive framework model with transactions at interfaces with both the production system and the analytical IS. Its coarse structure is the classical perception–action cycle influenced by goals and outcome feedback. In the highly uncertain production environment of Australian dryland farming, personal judgement plays a significant mediating role between perception and action, and theory of a continuum between the judgement modes of intuition and analysis adds to framework structure. Further structure comes from the theoretical distinctions between holistic and arbitrary intuition, and between causal and probabilistic analysis. Analytic interventions influence: (a) awareness of current situation conditions and (b) expectations of future conditions and action outcomes, and these serve as primary cognitive resources for evaluation of possible actions in planning and decision making. A theory that matches our research experience in bridging the gap between analytic intervention and intuitive practice posits that virtual situations simulated with analytic models and outputs represented graphically can facilitate vicarious experiential learning. This dovetails with theory concerning the education of intuition.

The paper concludes by applying criteria from the field of cognitive engineering to test whether the framework presents a concept of mind that is workable for informing practical model-based research and development aimed at supporting farmers' judgments and decisions.

Mounicou S., J. Szpunar, D. Andrey, C. Blake, and R. Lobinski. 2003. Concentrations and bioavailability of cadmium and lead in cocoa powder and related products. *Food Additives and Contaminants*, 20:343-352.

Reference ID: 22734

Notes: H 8.1.4 #22734e

Abstract: Concentrations and bioavailability of cadmium (Cd) and lead (Pb) were determined in cocoa powders and related products (beans, liquor, butter) of different geographical origins. Particular attention was paid to the fractionation of these metals, which was investigated by determining the metal fraction soluble in extractant solutions acting selectively with regard to the different classes of ligands. The targeted classes of Cd and Pb species included: water-soluble compounds, polypeptide and polysaccharide complexes, and compounds soluble in simulated gastrointestinal conditions. The bioavailability of Cd and Pb from cocoa powder, liquor and butter was evaluated using a sequential enzymolysis approach. The data obtained as a function of the geographical origin of the samples indicated strong differences not only in terms of the total Cd and Pb concentrations, but also with regard to the bioavailability of these metals. The Cd concentrations in the cocoa powders varied from 94 to 1833gkg⁻¹, of which 10-50% was potentially bioavailable. The bioavailability of Pb was generally below 10% and the concentrations measured in the cocoa powders were in the 11-769gkg⁻¹ range. Virtually all the Cd and most of Pb were found in the cocoa powder after the pressing of the liquor.

Naylor R. L., W. P. Falcon, D. Rochberg, and N. Wada. 2001. Using El Niño/Southern Oscillation Climate Data to Predict Rice Production in Indonesia. *Climatic Change*, 50:255-265.

Reference ID: 22735

Notes: #22735e

Abstract: Despite the strong signal of El Niño/Southern Oscillation (ENSO) events on climate in the Indo-Pacific region, models linking ENSO-based climate variability to seasonal rice production and food security in the region have not been well developed or widely used in a policy context. This study successfully measures the connections among sea surface temperature anomalies (SSTAs), rainfall, and rice production in Indonesia during the past three decades. Regression results show particularly strong connections on Java, where 55% of the country's rice is grown. Two-thirds of the interannual variance in rice plantings and 40% of the interannual variance in rice production during the main (wet) season on Java are explained by year-to-year fluctuations in SSTAs measured 4 and 8 months in advance, respectively. These effects are cumulative; during strong El Niño years, production shortfalls in the wet season are not made up later in the crop year. The analysis demonstrates that quantitative predictions of ENSO's effects on rice harvests can provide an additional tool for managing food security in one of the world's most populous and important rice-producing countries.

Negash M. and M. Starr. 2015. Biomass and soil carbon stocks of indigenous agroforestry systems on the south-eastern Rift Valley escarpment, Ethiopia. *Plant and Soil*, 1-13.

Reference ID: 22736

Notes: #22736e

Abstract: *Background and Aims* Biomass carbon (C) and soil organic carbon (SOC) stocks in three indigenous agroforestry (AF) systems (Enset [*Ensete ventricosum*, Musaceae], Enset-Coffee and Fruit-Coffee) practiced on the Rift Valley escarpment of

Ethiopia are presented and evaluated. These unique AF systems are characterized by a high proportion and diversity of trees.

Methods Data were collected from six smallholdings per AF system. Above- and belowground biomass of trees (fruit and non-fruit), enset and coffee plants were calculated using allometric equations while the biomasses of herbs, litter and fine roots (<2 cm) were determined by destructive sampling techniques. SOC stocks (0-30 and 30-60 cm) were calculated from measured C contents and bulk density values.

Results Smallholding total biomass C stocks averaged 67 Mg ha⁻¹ with trees accounting for 39-93 %. Herbs accounted for <4 % of aboveground biomass. Coffee accounted for 11 % and enset 9 % of total biomass C on average. SOC stocks (0-60 cm) were 109-253 Mg ha⁻¹ (52-91% of total C stocks) and uncorrelated to biomass C stocks. Biomass C or SOC stocks did not significantly differ between AF systems but biomass C stocks were significantly correlated to elevation.

Conclusions The C stocks of the three studied AF systems were found to be amongst the highest reported for tropical forests and agroforestry systems. These unique AF systems are therefore well suited to REDD+ projects. However, the C stocks were more determined by individual smallholder management practice than by AF system or climate (elevation).

Meijaard E. and D. Shell. 2013. Oil-Palm Plantations in the Context of Biodiversity Conservation. Pages 600-612 *in* SA Levin, editor. Encyclopedia of Biodiversity. Elsevier Inc.

Reference ID: 22737

Notes: #22737e

Abstract: Few topics provide as much controversy in tropical forest and wildlife conservation as the rapid expansion of oil palm (*Elaeis guineensis*) plantations. On the one hand, oil palm has been linked to deforestation, peat degradation, biodiversity loss, forest fires, and a range of social issues (Danielsen et al., 2009; Koh and Wilcove, 2008, 2009; Sheil et al., 2009; Sodhi et al., 2010). On the other hand, oil-palm expansion is considered a powerful driver of economic development in tropical countries with low levels of welfare (Casson, 2000; McCarthy and Zen, 2010; Sheil et al., 2009; World Growth, 2011), and it has been referred to as "green gold" (Friends of the Earth, 2008). Economic development can lead to reduced levels of forest loss, and biofuels from oil palm can reduce global carbon emissions, but the unanswered question is whether, at a global scale, do the benefits of oil palm outweigh the environmental costs? With much of Earth's species diversity residing in tropical areas where oil palm thrives, there seems ample reason to closely assess the role that oil palm has played in tropical deforestation and loss of wildlife. Here the authors review the role of oil palm in biodiversity loss and conservation by assessing its impacts over a range of different spatial scales and in different socioecological contexts.

Rusan M. J. M. and H. I. Malkawi. 2016. Dilution of olive mill wastewater (OMW) eliminates its phytotoxicity and enhances plant growth and soil fertility. *Desalination and Water Treatment*, 1-10.

Reference ID: 22738

Notes: #22738e

Abstract: Olive Mill Wastewater (OMW) is phytotoxic and all attempts to treat it are expensive and therefore alternative less expensive treatment techniques should be developed. The objective of this study is to determine whether the dilution of OMW with water improves its suitability for soil application and enhances plant growth without polluting the environment. The following treatments were investigated in a

randomized complete block design with four replications in a greenhouse pot experiment: (1) potable water (W); (2) undiluted OMW (100% OMW); (3) diluted OMW at a ratio of 1water:3OMW (75% OMW); (4) diluted OMW at a ratio of 1water:1OMW (50% OMW); and (5) diluted OMW at a ratio of 3water:1OMW (25% OMW). Pots filled with 5 kg air-dry soil and seeded with maize were watered according to the treatments. At the end of the growing period, plant and soil samples were collected for analysis. The results indicated that undiluted OMW reduced plant growth and increased soil salinity. Diluted OMW reduced its phytotoxicity, increased soil organic matter, N, P, and K. However, even diluted OMW increased soil salinity so this should be taken into consideration with continuous OMW application. It was concluded that diluted OMW (25% OMW) eliminated OMW phytotoxicity and enhanced plant growth. Such approach is a practical alternative to the expensive non-affordable by the owners of mills treatments techniques.

Rusan M. J. M., A. A. Albalasmeh, S. Zuraiqi, and M. Bashabsheh. 2015. Evaluation of phytotoxicity effect of olive mill wastewater treated by different technologies on seed germination of barley (*Hordeum vulgare* L.). Environmental Science And Pollution Research, 1-11.

Reference ID: 22739

Notes: #22739e

Abstract: Olive-mill wastewater (OMW) is a by-product effluent of olive oil extraction process that is produced in large amount in theMediterranean region.OMW is believed to induce phytotoxic effect on organisms including seed germination and plant growth. The objective of this study was to evaluate the impact of untreated and treated OMW with different techniques on seed germination of barley (*Hordeum vulgare* L.). The following treatments were investigated: (1) tap water (control); (2) OMW treated by aerobic biological technology in a Jacto Reactor (JR); (3) OMW treated by solar fenton oxidation (SFO); (4) OMW treated by microfiltration followed by nanofiltration (MF+NF); (5) OMW treated by microfiltration followed by reverse osmosis (MF+RO) process; (6) diluted OMW with tap water (25 % OMW); (7) diluted OMW with tap water (50 % OMW); (8) diluted OMWwith tap water (75 % OMW); and (9) untreated OMW (100 % OMW). A germination test was conducted in an incubator at temperature of 23 .C. In each petri dish, a filter paper was mounted and ten seeds of barley were placed on the filter paper. Five milliliter of water were added to each petri dish. The seed germination was determined by counting the number of germinated seeds to calculate the percentage of germination (G %). Germination rate index (GRI), seed vigor index (SVI), and phytotoxicity index (PI) were also calculated. Then, the dry weights and lengths of the shoots and the roots of the germinated seeds were measured. The results show that 100, 75, and 50%OMW were very phytotoxic and completely prohibited seed germination. However, phytotoxicity decreased significantly following treatments of OMW with all techniques investigated and by the 25 % OMW dilution, as results of removing the phenols and other phytotoxic organic compounds from the OMW or by diluting it. This was evidenced by relative enhancement of the dry weights and lengths of shoot and root as well as the G %, GRI, SVG, and PI. It was concluded that if OMW will be used for irrigating crops, it has to be first treated or diluted with tap water at a ratio of 1:3 OMW:water at least. The most efficient treatment techniques in reducing the phytotoxicity of OMW were the MF+RO, followed by SFO and JR.

Rusan M. J. M., A. A. Albalasmeh, and H. I. Malkawi. 2016. Treated Olive Mill Wastewater Effects on Soil Properties and Plant Growth. *Water Air Soil Pollution*, 227:1-10.

Reference ID: 22740

Notes: #22740e

Abstract: Olive-oil production has a vital impact on the socioeconomic development in most Mediterranean countries, where 97.5 % of the world oil is produced. However, the olive-oil extraction process generates considerable quantities of an agro-industrial effluent, olive mill wastewater (OMW), which has negative impact on the environment and biological life. The objective of this study was to evaluate the potential use of OMW treated by different technologies in irrigation and determine its effect on the plant growth and soil quality parameters. Different technologies were used to treat the OMW, the resultant treated OMW was used to irrigate the maize planted in the pot experiment. The results indicated that UOMW increased soil salinity and reduced plant growth, while the treated OMW by different technologies improved plant growth and resulted in lower soil pH. The impact on other soil properties varied depending on the techniques used for treatments. Although treated OMW enhanced plant growth compared with the untreated, the plant growth remained lower than that obtained using the potable water with fertilizers, indicating lack of some essential plant nutrients.

IPNI. Plant Nutrition Today - Summer 2016. 1-8. 2016. Georgia USA, IPNI.

Reference ID: 22741

Notes: #22741e

Rosazlin A., C. I. Fauziah, K. Wan Rasidah, A. B. Rosenani, and D. R. Kala. 2011. Assessment on the Quality of Recycled Paper Mill Sludge Mixed with Oil Palm Empty Fruit Bunch Compost. *Malaysian Journal of Soil Science*, 15:49-62.

Reference ID: 22742

Notes: #22742e

Abstract: Recycled Paper Mill Sludge (RPMS) is currently disposed off in the landfill and the costs are becoming expensive. Therefore, an alternative disposal through land application of RPMS and empty fruit bunches (EFB)(as a bulking agent) compost requires investigation. This study was conducted to determine the physico-chemical characteristics of composted RPMS and EFB mixtures, their phytotoxicity and the effect of the composts on plant growth performance. Composting experiment was arranged in a completely randomized design (CRD) with four replicates. The RPMS were mixed with EFB in 3 ratios, that is 1:1, 1:2 and 1:3 (RPMS:EFB) based on volume/volume. The mixtures were filled in a polystyrene box up to 90% volume and water was sprinkled onto the compost (50% moisture content) to accelerate decomposition. During composting, the compost was turned every three days to ensure that the material on the outside of the pile was turned from the center outwards to dissipate heat. The RPMS and EFB compost mixtures were evaluated for physical, chemical, phytotoxicity and short term plant growth effects. These compost mixtures had no toxicity effects on plants, had 100% seed germination, high in nutrient contents, low in C/N ratio and had fine particle size of <18mm. The concentrations of heavy metals were also within the recommended level of the Council of European Communities (CEC) for compost. Compost produced from a ratio of 1:1 volume is suitable for land application as compared to 1:2 and 1:3 (RPMS:EFB). However, further study should be carried out to evaluate the effect of raw and RPMS compost on soil fertility, plant productivity and quality.

Wicke, B., Sikkema, R., Dornburg, V., Junginger, M., and Faaij, A. Drivers of Land Use Change and the Role of Palm Oil Production in Indonesia and Malaysia: Overview of Past Developments and Future Projections - Final Report. 1-119. 2008. The Netherlands, Copernicus Institute.

Reference ID: 22743

Notes: #22743e

Abstract: This study provides insight into land use changes (LUC) in Indonesia and Malaysia and into the specific role that palm oil production and its expansion have played in the past and may play in the future in both countries. In relation to future land use changes induced by palm oil production expansion also the GHG emissions of this LUC are analysed to indicate the sustainability (from a GHG emission perspective) of the various palm oil expansion projections.

Howeler R. H., D. G. Edvards, and C. J. Asher. 1982. Micronutrient deficiencies and toxicities of cassava plants grown in nutrient solutions I. Critical tissue concentrations. *Journal of Plant Nutrition*, 5:1059-1076.

Reference ID: 22744

Notes: #22744e

Abstract: The programmed nutrient addition technique was used in a series of 5 experiments to determine the response in growth and micronutrient content of cassava (*Manihot esculenta* Crantz) cv. M Aus 10, to 8 supply levels of boron, copper, iron, manganese and zinc respectively. The experiments were of 9 weeks duration and utilized 22 litre pots of nutrient solution. The supply levels for each micronutrient covered the range from severe deficiency to toxicity. Critical tissue concentrations for deficiencies determined by relating total dry matter production to the nutrient concentration in the youngest fully expanded leaf blades were (µg/g): boron 35, copper 6, manganese 50, and zinc 30. Likewise, critical concentrations for toxicities in the same index tissue were (µg/g): boron 100, copper 15, manganese 250, and zinc 120. In the iron experiment, the data were too variable to allow precise determination of critical concentrations for deficiency and toxicity. Critical micronutrient concentrations in the petioles of the youngest fully expanded leaves were also determined, but offered no advantage over the leaf blades.

MOSTA. Malaysian Oil Science and Technology MOST Vol 24 No 2. MOST 24[2], 38-82. 2016.

Reference ID: 22745

Notes: S 8.1.1 #22745

Hassan H., B. Y. C. Lau, and U. S. Ramli. 2014. Extraction Methods for Analysis of Oil Palm Leaf and Root Proteins by Two Dimension Gel Electrophoresis. *Journal of Oil Palm Research*, 26:54-61.

Reference ID: 22746

Notes: #22746e

Abstract: Oil palm (*Elaeis guineensis* jacq.) is an important crop in Malaysia, and as such, it has become the second largest export earner for the country. This study ventured into developing suitable gel-based proteomics methods for specific oil palm tissues with the aim of understanding its biological systems. An optimal procedure for extraction of proteins from oil palm root and leaf tissues was developed through evaluations and modifications of three existing methods. The TCA/acetone, phenol/ammonium acetate and chloroform/ acetone protein extraction approaches were tested on the root and leaf tissues of oil palm. The total protein yields and

resulting 2-DGE protein spot profiles revealed that TCA/acetone method is the most effective approach for both tissues. Thus, TCA/acetone method will be used to produce total proteins for downstream analyses by mass spectrometry.

Oviasogie P. O., A. E. Aghimien, and C. L. Ndiokwere. 2011. Fractionation and bioaccumulation of copper and zinc in wetlands soils of the Niger Delta determined by the oil palm. *Chemical Speciation & Bioavailability*, 23:96-109.

Reference ID: 22747

Notes: #22747e

Abstract: The concentration, mobility, bioavailability, distribution and associations of two essential micronutrient elements (copper and zinc) to the oil palm in wetland soils of the Niger delta region of Nigeria was assessed by means of chemical fractionation analysis. The water soluble and plant available fractions were introduced into the sequential extraction scheme. Also assessed were the bioaccumulation (concentration and distribution) of these metals in the leaves and fruits of the oil palm of various ages found around the soil profiles. Copper was obtained more in the amorphous Fe-oxide fraction (151.05 mg kg⁻¹), but evenly distributed in the exchangeable component (16.16%) with a maximum value of 126.6 mg kg⁻¹. The water soluble and plant available fractions had 16.15 and 7.54% distribution of Cu respectively. Zinc had 2.35 and 30.42% distribution in the water soluble and plant available fractions respectively. The lowest mean amount of Cu (1.33mg kg⁻¹) was determined in the leaves of palms of ages 15-32 years. Palms greater than 60 years had the highest mean concentration of copper (3.91 mg kg⁻¹) in the leaves while the endosperm (kernel) of palms between 2 and 10 years had concentration of 9.07 mg kg⁻¹. The fibrous oily mesocarp had the highest amount (16.78 mg kg⁻¹) of copper in the older palms (460 years). Similarly, Zn was dominant in the older palms with a mean concentration of 187.14 mg kg⁻¹ obtained in the endosperm (kernel). The bioaccumulation pattern of both metals by the palms irrespective of age and the fractionation analysis revealed sufficient bioavailable and reserved amounts of Zn and Cu in the wetland soils.

Schuchardt F., K. Wulfert, Darnoko, and T. J. Herawan. 2008. Effect of New Palm Oil Mill Processes on the EFB and POME Utilization. *Journal of Oil Palm Research*, S1:115-126.

Reference ID: 22748

Notes: #22748e Note: Conference Paper 2007 same title and author #20512

Abstract: New palm oil mill processes are characterized by advanced oil separation technologies with zero dilution water ('ECO-D' for example as a new system for oil recovery without dilution water) and continuous sterilization of the fresh fruit bunch (FFB). These processes have a deep impact on the amount and composition of waste water (POME). Compared to conventional palm oil mills the total amount of palm oil mill effluent (POME) can be reduced from 0.65 m³ t⁻¹ FFB to 0.45 m³ t⁻¹ (conventional sterilization and zero dilution water) and 0.25 m³ t⁻¹ (continuous sterilization and zero dilution water). These changes influence the treatment processes and its cost significantly. One process for the EFB and POME utilization which can fulfil the demand of a sustainable palm oil production is the co-composting of both of the materials. The Composting process is used also for biological drying of the POME. The final product of the process is compost or mulch which unifies the nutrients of both in one product. The POME can be used also for bingos production (in fixed bed reactors for POME with low dry matter content and in totally mixed reactors for ECO-D biomass) before composting. The investment cost and profitability

of the composting and fermentation process is calculated in detail based on data from practise in Indonesia. The new developments of processes in palm oil mills can reduce the cost for the waste and waste water treatment up to 35%. The benefits from bingos production and composting are the energy production, saved POME treatment cost in pond systems, total utilization of the POME nutrients, reduced cost for the EFB transport and utilization, higher empty fruit bunch (FFB) yields and from clean development mechanism (CDM).

Salétes S., F. A. Siregar, J.-P. Caliman, and T. Liwang. 2004. Ligno-cellulose Composting: Case Study on Monitoring Oil Palm Residuals. *Compost Science & Utilization*, 12:372-382.

Reference ID: 22749

Notes: #22749e

Abstract: Oil palm empty fruit bunches (EFB) composting is increasingly being considered by tropical farmers as a worthwhile alternative to direct spreading in the field. EFB are ligno-cellulose residues comprising 46% cellulose and 16.5% lignin with a high C:N ratio ranging from 45 to 70. In hot regions, it is essential to control variations in the water content of the substrate. This case study set out to optimize the EFB composting procedure by monitoring two key factors, namely the nutritional balance of the biomass and its water content. The trial was conducted on a composting platform belonging to the PT SMART Tbk company (Indonesia) in windrows comprising shredded EFB watered weekly with oil mill effluents. The quantity of effluent to be added was calculated so as to systematically top up to 60% humidity. The initial C:N ratio of the EFB was reduced by urea and/or ripe compost applications (seeding). Application times and rates were studied on two windrows, one in an open area, the other in an area sheltered by a roof to prevent over-rapid drying. After ten weeks the compost could be considered ripe for all the treatments; at that stage, composting had reduced the volume and initial weight of the fresh EFB by 85% and 50% respectively. The combined action of a temperature rise and windrow turning led to substantial water losses through evaporation, resulting in a sudden drop in windrow humidity at the start of composting. When rainfall was insufficient, effluent applications became essential. The total amount of effluent to be applied during composting (without rainfall) was around 3 m³ per initial tonne of EFB. This amount approximately corresponded to the standard effluents : EFB ratio in the oil mill. Inoculation of the mass of EFB to be composted with ripe compost had a significant effect on the speed with which the mixture was reduced. A urea application a fortnight after the start of fermentation seemed to be beneficial. The resulting compost had a good agronomic value. However, the mineral balance was considerably affected, as the nutrients provided by the effluents were poorly retained by the substrate, and partially lost in percolation water following the weekly watering operations. For instance, almost 50% of the phosphorus, 70% of the potassium, 45% of the magnesium and between 10% and 20% of the calcium theoretically applied were lost ten weeks into the trial. Better distribution of the effluent applications, combined with a system to recover the leachings, should substantially reduce these losses, while maintaining suitable humidity for microbial degradation.

Abdul Khalil H. P. S., M. Siti Alwani, R. Ridzuan, H. Kamarudin, and A. Khairul. 2008. Chemical Composition, Morphological Characteristics and Cell Wall Structure of Malaysian Oil Palm Fibers. *Polymer-Plastics Technology and Engineering*, 47:273-280.

Reference ID: 22750

Notes: #22750e

Abstract: This article deals with the determination of chemical composition and the study of morphological and cell wall structure of oil palm fibers. Cellulose is the main constituent in oil palm fibers, and oil palm trunk (OPT) fiber exhibited the highest content of extractives and lignin. Fiber morphological determination also showed that OPT fibers have the highest fiber length, diameter, and cell wall thickness. Observations of fiber cell wall layers using transmission electron microscopy at ultrastructure level confirmed that cell wall layers of oil palm fiber have a structure similar to that of wood cell wall. Analysis also focused on the determination of lignin distribution within the cell wall layers using toluidine blue. In all fiber samples, the middle lamella appeared to demonstrate a higher level of lignification compared to that of other cells.

Hanafi M. M. and G. J. Maria. 1998. Cadmium and Zinc in Acid Tropical Soils: III. Response of Cocoa Seedlings in a Greenhouse Experiment. *Communications in Soil Science and Plant Analysis*, 29:1949-1960.

Reference ID: 22751

Notes: H 8.1.4 #22751e

Abstract: Many phosphate rock (PR) materials used as direct application of fertilizer containing variable amounts of heavy metals, such as cadmium (Cd) and zinc (Zn). The effect of Cd and Zn addition to unlimed and limed (pH 5.5) soils on the growth of cocoa seedlings (*Theobroma cacao* L.) U1T1 X NA33 hybrid was conducted in the field at Kunak, Tawau, Sabah. Cadmium [as Cd(SO₄ · 8H₂O)] and Zn [as Zn(SO₄ · 7H₂O)] were added in solution form at 0, 2.8, 14, and 28 kg Cd ha⁻¹ year⁻¹ and 0, 28, 140, and 280 kg Zn ha⁻¹ year⁻¹ respectively, to each of three top (0-15cm) soils from Katai (Typic Hapludult), Koyah (Oxic Dystropept), and Table (Typic Hapludox). At harvest, plant growth parameters, plant height and plant dry-matter yield, were measured. Cadmium and Zn contents were partitioned into plant roots, stems, leaves, and in the soils. Plant height and dry-matter yield of cocoa differed markedly between levels of Cd and Zn added to unlimed and limed soils. A positive plant growth response of the added Cd and Zn was clearly apparent in the Table soil as compared to the Katai and Koyah soils. A significant increase (p<0.05) in all plant growth parameters was obtained at the concentration of 2.8 mg Cd kg⁻¹ and 28 kg Zn kg⁻¹ added to the limed soils. In contrast, a significant (p<0.05) reduction of the parameter measured was obtained in unlimed soils at a concentration of more than 14 mg Cd kg⁻¹ and 140 mg Zn kg⁻¹ of soil. Analysis of the Cd and Zn contents showed that substantial amounts of these elements accumulated in the leaves, stems, and roots of cocoa, while very little were present in the soils. Liming the soils before the addition of Cd and Zn significantly (p<0.05) reduced the amount of metal accumulation in these plant parts.

Ojeniyi S. O., N. E. Egbe, and T. I. Omotosho. 1981. Boron Nutrition of Amazon Cocoa (*Cacao theobroma*) in Nigeria. I. Early Results of Fertilizer Trials. *Experimental Agriculture*, 17: 399-402.

Reference ID: 22752

Notes: #22752e

Abstract: Boron treatment was superimposed on half of 48 Amazon cocoa NK-treated plots in four locations across Southern Nigeria. Boron was deficient in soil and leaves of untreated 12-year-old Amazon cocoa, but boron treatment increased bean yield from 13 to 70%. Application of N and K fertilizers reduced the impact of soil-applied boron.

Asomaning E. J. A., R. S. Kwakwa, and W. V. Hutcheon. 1971. Physiological studies on an Amazon shade and fertilizer trial at the Cocoa Research Institute, Ghana. *Ghana Journal of Agricultural Science*, 41:47-64.

Reference ID: 22753

Notes: #22753e

Abstract: Data on flushing, flowering, pod setting, cherelle wilting and production of mature pods under various regimes are presented and analysed to give information on the physiological basis of yield differences. Deshading and NPK fertilizer application promoted flushing and significantly increased flower numbers. Most cherelles set on lightly-shaded, fertilized cocoa. Pod setting pattern was not reflected in that of mature pod production, the latter being markedly altered by the degree of cherelle wilt. Final yield bore no relation to the degree of flowering and setting, and was apparently limited by the nutritional status of the tree. Deshading and fertilizer application effected a 10 per cent and 2 per cent reduction in wilt respectively. Possible mechanisms of cherelle wilt are discussed critically, the present result suggesting the involvement of carbohydrates and possibly minerals. Seasonal patterns of physiological behaviour and climate are presented and the phenology of cocoa is discussed in detail. Flushing occurred in cycles throughout the year, apparently being promoted by adequate soil moisture and high temperature or radiation. Flowering pattern could not be readily explained, though, in general, it corresponded with that of rainfall. Pod setting and cherelle wilting accentuated earlier flower peaks to give very marked cropping periods.

Ahenkorah Y., B. J. Halm, M. R. Appiah, G. S. Akrofi, and J. E. K. Yirenkyi. 1987. Twenty Years' Results from a Shade and Fertilizer Trial on Amazon Cocoa (*Theobroma cacao*) in Ghana. *Experimental Agriculture*, 23:31-39.

Reference ID: 22754

Notes: #22754e

Abstract: The effects of three shade (*Terminalia ivorensis*) densities, NPK fertilizers and fertilizer-pest (*Bathycoelia thalassina* and *Helopeltis* spp.)/disease (*Phytophthora palmivora*) relationship on Amazon cocoa are reported. Yields equivalent to the mean yield over 20 years from the unfertilized plots were achieved in about 3, 4 and 6 years in fertilized plots under no shade (S_0), medium shade (S_1) and heavy shade (S_2), respectively. There were three growth phases, each characterized by a different yield trend: the first 7-8 years characterized by the highest yields and widest yield fluctuations; a stable phase lasting for 5-6 years with a steady rise in yield (fertilizer + S_0) or a yield plateau and gentle fluctuations; and a final senescent phase with a rapid yield decline noticed first in (S_0). No appreciable changes in exchangeable soil Ca and Mg were observed during the experiments, but K dropped to 68% of its initial value while available P of the unfertilized and the S_0 plots fell by 38%. Fertilizer recommendations for P and K should take account of overhead shade. The effect of N application was often negative. No direct relationship was observed between fertilizer treatment and the incidence of pest/blackpod/swollen shoot virus (SSV). SSV infection was greatest under S_0 . Cocoa farms in Ghana could not maintain high yields (about 1000 kg dry cocoa/ha) beyond 15 years with intensive cropping.

Wade A. S. I., A. Asase, P. Hadley, J. Mason, K. Ofori-Frimpong, D. Preece, N. Spring, and K. Norris. 2010. Management Strategies for Maximizing Carbon Storage and Tree Species Diversity in Cocoa-growing Landscapes. *Agriculture, Ecosystems & Environment*, 138:324-334.

Reference ID: 22755

Notes: H 8.1.4 #22755e

Abstract: How do we manage the trade-offs between agricultural yields, biodiversity and ecosystem services? One option is to adopt high yield, intensive farming that allows land to be spared elsewhere for conservation (land sparing); another is to adopt low yield, extensive farming over a greater area that retains more biodiversity and protects ecosystem services (wildlife-friendly farming). We examine which is likely to be the best option to achieve high carbon storage and tree species richness in tropical cocoa-growing landscapes. Increased management intensity explained higher yield and in turn this explained a reduction in carbon storage and species richness. Substantial differences in species richness between forest and cocoa farms suggested that land sparing would conserve more tree species than wildlife-friendly farming. The optimal strategy for carbon storage depends on the cocoa yield in the wildlife-friendly farming system. At low cocoa yields, wildlife-friendly farming is the best option; whereas at higher yields land sparing is best. Our results suggest that the best land management strategy for biodiversity and ecosystem services might differ depending on details of the farming systems involved. Management of the trade-offs between agriculture, biodiversity and ecosystem services in tropical forest landscapes needs to consider current and expected future yields.

Padi F. K., S. Y. Opoku, B. Adomako, and Y. Adu-Ampomah. 2012. Effectiveness of juvenile tree growth rate as an index for selecting high yield cocoa families. *Scientia Horticulturae*, 139:14-20.

Reference ID: 22756

Notes: #22756e

Abstract: Understanding the relationship between vegetative vigor and productivity in cocoa is critical to maximizing yield per unit area in cocoa plantations. Three trials established from either progenies of self mating of 24 clones of Upper Amazon origin, or from progenies of mating among clones recommended as parents for production (Seed Garden clones) or from progenies of inter- and intra-group mating of selected clones were analyzed for their vigor and yield relationships over a period of 10 years. The rate of increase in tree trunk cross-sectional area (TCSA) prior to bearing was an effective parameter in identifying families with large cumulative yields over the first five or six production years. Families with slow increase in juvenile TCSA were particularly of low bean yields. Though girth of adult trees was generally correlated with cumulative yields, a consistent relationship between tree girth at the end of the 10th year and yield efficiency was not observed. Yield efficiency was significantly correlated with cumulative yield, and showed predominantly additive gene action. The combined selection for rapid increase in juvenile tree TCSA and precocity have the potential of identifying high yielding families early in a cocoa breeding program.

Lachenaud P., D. Paulin, M. Ducamp, and J. M. Thevenin. 2007. Twenty years of agronomic evaluation of wild cocoa trees (*Theobroma cacao* L.) from French Guiana. *Scientia Horticulturae*, 113:313-321.

Reference ID: 22757

Notes: #22757e

Abstract: Almost 500 clones of wild cocoa trees (*Theobroma cacao* L.) grown from pods collected in 1987 from wild mother-trees in the Camopi and Tanpok river basins (southeastern French Guiana) have been distributed in around fifteen cocoa producing countries since 1988. The name of those clones always bears the GU prefix (for "Guyane", i.e. French Guiana). All the germplasm of the same geographical origin present in the CIRAD collection at Paracou-Combi (Sinnamary, French Guiana), i.e. more than 1600 trees, has been abundantly studied for its morphological characterization, its agronomic assessment or its genetic diversity. Other assessment work, primarily on resistance to certain diseases, has been carried out by CIRAD in Montpellier, or in various countries by other organizations.

In order to simplify the choice for breeders faced with a large number of GU clones and wishing to use some of them, an overview is presented here of the results obtained with this germplasm for various selection criteria such as productivity, the yield:vigour ratio (cropping efficiency), pod filling, bean size, resistance to pests and diseases, compatibility, sensory qualities, etc. The results obtained for resistance of this material to witches' broom disease and black pod rot show a globally high level of resistance, making the GU germplasm a new and major potential source of resistance to those diseases. The same seems to apply for resistance to mirid damage. The yield levels achieved in French Guiana, along with cropping efficiency, are noteworthy in some families. The first results acquired reveal a substantial heterosis effect when GU clones are hybridized with other groups.

Given their distribution in several countries, the known individual qualities and performance of some GU clones present at the Reading quarantine station (UK) are indicated. A selection of clones that are of interest or promising for incorporation in breeding programmes is provided for each criterion.

OXFAM. Feeding Climate Change: What the Paris Agreement means for food and beverage companies. 1-37. 2016.

Reference ID: 22758

Notes: H 17 #22758

Abstract: The Paris Agreement marked a major breakthrough in support for climate action from many parts of the business community, including from key actors in the food and beverage sector. But despite significant progress, much work remains both to cut greenhouse gas emissions and to support the millions of people already hit by climate change.

As one of the sectors that is at highest risk of being affected by climate change, responsible for a giant emissions footprint and reliant on millions of small-scale farmers and agricultural workers in the regions most vulnerable to climate change, the food and beverage sector should lead the next generation of post-Paris corporate climate commitments.

This paper presents new data commissioned from the research consultancy CE Delft on the greenhouse gas emissions footprints and water scarcity footprints of major food commodities. The data demonstrate the vital role the food and beverage industry can and must play in turning the Paris Agreement into a springboard for the stronger climate action needed.

Lockwood G. and J. T. Y. Pang. 1996. Yields of Cocoa Clones in Response to Planting Density in Malaysia. *Experimental Agriculture*, 32:41-47.

Reference ID: 22759

Notes: #22759e

Abstract: Ninety five cocoa clones were tested in Sabah, Malaysia at planting densities of 1096 and 3333 plants ha⁻¹). Analysis of dry bean yields up to 60 months after planting showed that vigorous clones performed better at the lower planting density, some clones of intermediate vigour performed well at both planting densities and some weak clones performed well at high planting density. The conclusion that optimal planting densities are highly variable has significant implications for procedures in clone selection and suggests that the relation between the yield of a clone and its general combining ability will become clearer once planting density is taken into account.

Acquaye D. K. and R. W. Smith. 1965. Effects of Ground Covers and Fertilizers on Establishment and Yield of Cocoa on Clear-Felled Land in Ghana. *Experimental Agriculture*, 1:131-139.

Reference ID: 22760

Notes: #22760e

Abstract: Abstract: An experiment is described on the establishment of cocoa on clear-felled land, using various ground covers on which 2² NP:KMg factorial treatments were later superimposed. Growth of cocoa was improved in mulched and clean-weeded plots and the unshaded trees began bearing two years after planting, which is exceptionally early for young cocoa in Ghana. In the third year responses to NP fertilizer were obtained and in the following year yields were very high, up to 2170 pounds dry cocoa per acre. This was partly responsible for K deficiency, particularly in plots without mulch and KMg, which led to declining yields especially on the NP plots. Significant increases were thence obtained from the KMg fertilized plots. Mulching at the rates used in this experiment is too expensive and uneconomic, but K fertilizer applied at rates higher than the present rate of 75 lb K₂O/acre/annum may be needed on Ghanaian forest soils if they are clear-felled for growing unshaded cocoa.

Ali F. M. 1969. Effects of Rainfall on yield of Cocoa in Ghana. *Experimental Agriculture*, 5:209-213.

Reference ID: 22761

Notes: #22761e

Abstract: Effects of rainfall on yield of cocoa from a large-scale experiment has been investigated at 10 and 12 sites, over seven years, in the Eastern and Ashanti regions of Ghana. There was a positive association between yield and rainfall at certain times of year, but a negative association at other times. Variation due to the regression of yield on monthly rainfall varied up to 23 per cent, while a maximum variation of 31 per cent accounted for the regression of yield on the total rainfall of February to April in the Eastern region.

Neto A. P., J. L. Favarin, R. E. M. de Almeida, C. T. Dos Santos Dias, T. Tezotto, A. L. G. Alves, and M. F. Moraes. 2011. Changes in Nutritional Status during a phenological Cycle of Coffee under High Nitrogen Supply by Fertigation. *Communication Soil Science and Plant Analysis*, 42:2414-2425.

Reference ID: 22762

Notes: #22762e

Abstract: High-technology coffee cultivation systems involving fertigation commonly apply high rates of nitrogen (N). However, there is little information on the plants' uptake of N under these conditions. The objective of this study was to evaluate the changes in the nutritional status of coffee plants during a phenological cycle in response to N applied by fertigation. The study was conducted with 7-year-old trees

of *Coffea arabica* L., under pivot irrigation and fertigation, with five N rates (0, 200, 400, 600, and 800 kg ha⁻¹) applied on the plants. The changes in nutritional status were monitored during the phenological cycle, and the yield was measured at the end of the cycle. The N concentration increased with the N rates and varied with the phenological period, with the greatest concentration occurring during anthesis, the same as for the sulfur level. However, N rate did not affect the concentrations of other nutrients. The greatest concentrations of phosphorus, calcium, and magnesium were obtained in the final fructification phases and for potassium in the initial phases. Micronutrient concentrations were greater in the vegetative phases and anthesis but were reduced in the fruit-formation phase and increased again when the berries started to mature. The maximum yield, considering a relative production of 90%, was obtained with application of 415 kg ha⁻¹ of N. Leaf concentrations of N were directly related to the N rates, showing that the nutritional status of coffee plants can be evaluated in the ripening phase to adjust the fertilization parameters for the next year.

Ferreira A. D., A. M. de Carvalho, A. N. G. Mendes, G. R. Carvalho, C. E. Botelho, and G. R. Carvalho. 2010. Absorption, Translocation And Use Efficiency Of Nutrients In Coffee (*Coffea arabica* L.) Grafted On Apoata Iac 2258 (*Coffea canephora*): Absorção, translocação e eficiência no uso dos macronutrientes em cafeeiros (*Coffea arabica* L.) enxertados em Apoatã IAC 2258 (*Coffea canephora*). *Interciencia*, 35:818-822.

Reference ID: 22763

Notes: #22763e (journal is in portuguese)

Abstract: The different nutrient utilization rates by different species within the same genus, generally occur according to the variation in nutritional requirement, and to the ability for uptake, translocation and use of nutrients. The object of this study was to evaluate the efficiency of uptake, translocation and use of macronutrients in different cultivars of *Coffea arabica* L. Grafted into Apoata IAC 2258 (*Coffea canephora* Pierre ex A. Froehner). The experiment was carried out in a greenhouse at the Federal University of Lavras, Brazil, using the method of cultivation in nutrient solution. A 7x3+2 factorial design was used, with seven varieties of *C. arabica* L. (Palma II, Catucaí 2 SL, Oeiras, Obata, Acaua, Topazio MG 1190 and Paradise MG H 419-1), three types of seedlings (free standing, self-grafted and grafted on to root stock cv. Apoata IAC 2258) and two additional ones (self-grafted and Apoata). Data showed that the root stock used did not influence nutrient absorption except for potassium, which was increased. Nutrient translocation in grafted seedlings was higher than in free standing ones, except for sulfur Cultivar Topazio MG 1190 presented the lowest rates of use of nutrients, showing a low ability to be used as a crown in grafted seedlings.

Resumo: Os diferentes índices de aproveitamento dos nutrientes apresentados por espécies distintas dentro de um mesmo gênero, geralmente se dão em função da variação na exigência nutricional, e ainda na capacidade de absorção, translocação e utilização dos nutrientes. Dessa forma o objetivo do presente trabalho foi avaliar a eficiência de absorção, translocação e uso dos macronutrientes por diferentes cultivares de *Coffea arabica* L. enxertadas em Apoatã IAC 2258 (*Coffea canephora* Pierre ex A. Froehner). O experimento foi instalado em casa de vegetação da Universidade Federal de Lavras, Brasil, utilizando-se o método de cultivo em solução nutritiva. Foi utilizado um delineamento fatorial 7x3+2, sendo sete cultivares de *C. arabica* L. (Palma II, Catucaí 2SL, Oeiras MG 6851, Obatã IAC 1669-20, Acauã, Topázio MG 1190, e Paraíso MG H 419-1), três tipos de mudas (pé-franco, auto-enxertada e enxertada sobre o porta enxerto cv. Apoatã IAC 2258) e dois adicionais

(Apoatã auto-enxertado e Apoatã pé-franco). Foi possível concluir que o porta-enxerto utilizado não influenciou a absorção dos macronutrientes exceto para o potássio, que teve sua absorção aumentada. A translocação dos macronutrientes nas mudas enxertadas foi maior do que nas de pé franco à exceção do enxofre. A cultivar Topázio MG 1190 apresentou os menores índices de utilização dos nutrientes, demonstrando baixa aptidão para ser utilizada como copa em mudas enxertadas.

Vaast P., R. J. Zanuski, and C. S. Bledsoe. 1998. Effects of Solution pH, Temperature, Nitrate/Ammonium Ratios, Inhibitors on Ammonium and Nitrate Uptake by Arabica Coffee in Short-Term Solution Culture. *Journal of Plant Nutrition*, 21:1551-1564.

Reference ID: 22764

Notes: #22764e

Abstract: Solution pH, temperature, nitrate (NO₃⁻)/ammonium (NH₄⁺) ratios, and inhibitor; effects on the NO₃⁻ and NH₄⁺ uptake rates of coffee (*Coffea arabica* L.) roots were investigated in short-term solution culture. At intermediate pH values (4.25 to 5.75) typical of coffee soils, NH₄⁺ and NO₃⁻ uptake rates were similar and nearly independent of pH. Nitrate uptake varied more with temperature than did ammonium. Nitrate uptake increased from 0.05 to 1.01 $\mu\text{mol g}^{-1}\text{FW h}^{-1}$ between 4 and 16 degrees C, and increased three-fold between 16 to 22 degrees C. Between 4 to 22 degrees C, NH₄⁺ uptake rate increased more gradually from 1.00 to 3.25 $\mu\text{mol g}^{-1}\text{FW h}^{-1}$. In the 22-40 degrees C temperature range, NH₄⁺ and NO₃⁻ uptake rates were similar (averaging 3.65 and 3.56 $\mu\text{mol g}^{-1}\text{FW h}^{-1}$, respectively). At concentrations ranging from 0.5 to 3 mM, NO₃⁻ did not influence NH₄⁺ uptake rate. However, NO₃⁻ uptake was significantly reduced when NH₄⁺ was present at 3 mM concentration. Most importantly, total uptake (NO₃⁻+NH₄⁺) at any NO₃⁻/NH₄⁺ ratio was higher than that of plants fed solely with either NH₄⁺ or NO₃⁻. Anaerobic conditions reduced NO₃⁻ and NH₄⁺ uptake rate by 50 and 30%, respectively, whereas dinitrophenol almost completely inhibited both NH₄⁺ and NO₃⁻ uptake. These results suggest that Arabica coffee is well adapted to acidic soil conditions and can utilize the seasonally prevalent forms of inorganic N. These observations can help optimizing coffee N nutrition by recommending cultural practices maintaining roots in the temperature range optimum for both NH₄⁺ and NO₃⁻ uptake, and by advising N fertilization resulting in a balanced soil inorganic N availability.

Canell M. G. R. and B. Kimeu. 1971. Uptake and Distribution of Macro-Nutrients in Trees of *Coffea Arabica* L. in Kenya as Affected by Seasonal Climatic Differences and the Presence of Fruits. *Annals of Applied Biology*, 68:213-230.

Reference ID: 22765

Notes: #22765e

Abstract: Young to mature, conventionally managed, single-stem, deblossomed and fruiting Arabica coffee trees growing in a fertile lateritic clay loam at Ruiru, were uprooted at 2- to 3-monthly intervals between February 1967 and June 1968. Each was divided into ten parts which were dried, weighed, completely ground, and analysed for organic-N, and total P, K, Ca and Mg.

Mature trees took up about 100 g N, 6 g P, 100 g K, 35 g Ca and 10 g Mg each per annum, of which 8-29 % (depending on the element) would be removed in an average crop of fruits, and 50-81 % returned to the soil in prunings and fallen leaves. About half the P and K in senescing leaves was returned to the tree.

N, K, Ca and Mg uptake by deblossomed trees was relatively rapid when they produced a large post-drought 'flush' of shoot growth in February-April 1967. Thereafter uptake kept pace with changes in dry weight, and the concentration of N,

K, Ca and Mg in the tree parts changed relatively little. By contrast, P-uptake was relatively rapid over the cool, dry season 1967 (June-September), when the roots < 1 mm diameter grew rapidly, and during the subsequent Short Rains, but was slow during the hot, dry season 1968 (December-March) when the surface 2-3 ft of soil dried out. The concentration of P in the trees changed accordingly, especially in the branches. The flower buds took 39 % of the small total P-uptake during the hot, dry season 1968.

Trees bearing a light or moderate crop of fruits absorbed all the minerals determined more rapidly than deblossomed trees. The fruits on heavily fruiting trees took 89, 95, 98 and 99 % of the net current increment in Mg, K, organic-N and P, respectively, but only 39 % of the Ca. All leaves on the fruiting trees became rich in Ca, and most of their woody parts were depleted of P.

Mineral uptake in a coffee plantation is compared with that in plantations of other woody perennial crops, and some practical implications are noted in relation to soil and plant factors affecting the mineral nutrition of coffee in Kenya, with special reference to phosphates.

Tully K. L. and D. Lawrence. 2011. Closing the Loop: Nutrient Balances in Organic and Conventional Coffee Agroforests. *Journal of Sustainable Agriculture*, 35:671-695.

Reference ID: 22766

Notes: #22766e

Abstract: Agroforests are a primary example of ecologically sustainable agroecosystems due to their efficient use of natural resources and ability to buffer against ecological and socioeconomic stresses. We constructed nitrogen (N) and phosphorus (P) balances to examine the ecological sustainability of conventional, organic, and unfertilized coffee agroforests. A similar percentage of applied nutrients were recovered in conventional and organic coffee yields. However, nutrient excess (inputs minus outputs) was higher in conventional farms, suggesting they may be more prone to nutrient loss. Nutrient pools were large overall, with unfertilized farms tending to store nutrients aboveground, and fertilized farms belowground. Future research should investigate the fate of excess nutrients to develop specific strategies promoting nutrient optimization in agroforests.

Partelli F. L., H. D. Vieira, V. B. de Carvalho, and F. D. A. M. Filho. 2007. Diagnosis and Recommendation Integrated System Norms, Sufficiency Range, and Nutritional Evaluation of Arabian Coffee in Two Sampling Periods. *Journal of Plant Nutrition*, 30:1651-1667.

Reference ID: 22767

Notes: #22767e

Abstract: The objective of this work was to establish and compare Diagnosis and Recommendation Integrated System (DRIS) norms with the sufficiency range approach, and apply these methods on nutritional diagnosis of Arabian coffee, in field samples collected in summer and winter in Southern Brazil. DRIS norms and sufficiency range were established in groves with average biennial yield equal or above 3000 kg ha⁻¹. The " t " test was used to verify the differences between the sufficiency range and the DRIS norms. The foliar concentrations of nitrogen (N), phosphorus (P), and sulfur (S) were higher in summer, and iron (Fe), and manganese (Mn) in winter. The reference values should be specific for the period of the year. There were differences in the foliar nutritional diagnosis, between the DRIS method and the sufficiency range approach. In samples during the summer analyzed with DRIS,

copper (Cu), S, potassium (K), and zinc (Zn) were considered more limited nutrients and Mn, S, K, and calcium (Ca) when the sufficiency range was used.

Cohn A. S., L. K. VanWey, S. A. Spera, and J. F. Mustard. 2016. Cropping frequency and area response to climate variability can exceed yield response. *Nature Climate Change*, 7 March 2016:1-6.

Reference ID: 22768

Notes: H 0 #22768e

Abstract: The sensitivity of agricultural output to climate change has often been estimated by modelling crop yields under climate change scenarios or with statistical analysis of the impacts of year-to-year climatic variability on crop yields. However, the area of cropland and the number of crops harvested per growing season (cropping frequency) both also affect agricultural output and both also show sensitivity to climate variability and change. We model the change in agricultural output associated with the response of crop yield, crop frequency and crop area to year-to-year climate variability in Mato Grosso (MT), Brazil, a key agricultural region. Roughly 70% of the change in agricultural output caused by climate was determined by changes in frequency and/or changes in area. Hot and wet conditions were associated with the largest losses and cool and dry conditions with the largest gains. All frequency and area effects had the same sign as total effects, but this was not always the case for yield effects. A focus on yields alone may therefore bias assessments of the vulnerability of agriculture to climate change. Efforts to reduce climate impacts to agriculture should seek to limit production losses not only from crop yield, but also from changes in cropland area and cropping frequency.

Ma Q. F., R. Bell, C. Scanlan, G. Sarre, and R. Brennan. 2016. Drought and Soil Salinity Influence Response of Cereals to Potassium and Sulfur Fertilization. *Better Crops With Plant Food*, 100:20-22.

Reference ID: 22769

Notes: #22769e > S serial #22769e

Abstract: In sandy soils or acid lateritic soils containing kaolinitic clay with low CEC, considerable amounts of K can be lost by leaching (Sittiphanit et al., 2009). In Western Australia (WA), greater removal of K in hay, grain and straw than fertilizer K input has steadily increased the incidence of K deficiency on uniform deep sands and sandy duplex soils (sand over loam, clay or lateritic ironstone gravel) (Wong et al., 2000). In low K soils (less than 40 mg Colwell-K/kg), the reduction of wheat and barley growth is relatively greater in roots than shoots (Ma et al., 2011, 2013). The favoring of shoot growth at the expense of roots under K deficiency may, in turn, have a negative feedback on plant uptake of soil water and nutrients and thus make low K plants more vulnerable to drought and/ or salinity.

Argus FMB. *Fertilizer Focus July/August 2016*. Fertilizer Focus July/August 2016, 1-33. 2016. London, Argus Media.

Reference ID: 22770

Notes: #22770e

Belan L. L., E. A. Pozza, M. L. D. Freitas, A. A. A. Pozza, M. S. de Abreu, and E. Alves. 2014. Nutrients distribution in diseased coffee leaf tissue. *Australasian Plant Pathology*, 44:105-111.

Reference ID: 22771

Notes: #22771e

Abstract: Knowing the structure and distribution of nutrients in plant tissues can clarify some mechanisms of pathogen attack in plants and plant defense against infection, thus helping management strategies. The aim of this study was verify differences in distribution of mineral nutrients in coffee leaf tissues around foliar lesions of bacterial blight of coffee, blister spot, cercospora leaf, phoma leaf spot and coffee leaf rust. Fragments of leaf tissue surrounding the lesions were dehydrated in silica gel, carbon covered and subjected to Xray microanalysis (MAX). Thirty-three chemical elements were detected in leaf tissue; however, there was variation in potassium and calcium contents surrounding the lesions. The highest potassium content was found in asymptomatic tissues surrounding the lesions, decreasing toward the transition zone and reaching minimum content in symptomatic tissues. The highest calcium content was found in symptomatic tissues, decreasing toward the transition zone and reaching minimum content in asymptomatic tissues. Therefore, MAX can be used to analyze the composition and distribution of nutrients in plant tissues and, if associated with mineral nutrition, it may help understand host-pathogen relationships and plant disease management.

Rambo M. K. D., E. P. Amorim, and M. M. C. Ferreira. 2013. Potential of visible-near infrared spectroscopy combined with chemometrics for analysis of some constituents of coffee and banana residues. *Analytica Chimica Acta*, 775:41-49.

Reference ID: 22772

Notes: #22772e

Abstract: Banana (stalk, leaf, rhizome, rachis and stem) and coffee (leaf and husks) residues are promising feedstock for fuel and chemical production. In this work we show the potential of near-infrared spectroscopy (NIR) and multivariate analysis to replace reference methods in the characterization of some constituents of coffee and banana residues. The evaluated parameters were Klason lignin (KL), acid soluble lignin (ASL), total lignin (TL), extractives, moisture, ash and acid insoluble residue (AIR) contents of 104 banana residues (B) and 102 coffee (C) residues from Brazil. PLS models were built for banana (B), coffee (C) and pooled samples (B + C). The precision of NIR methodology was better ($p < 0.05$) than the reference method for almost all the parameters, being worse for moisture. With the exception of ash (B and C) and ASL (C) content, which was predicted poorly ($R^2 < 0.80$), the models for all the analytes exhibited $R^2 > 0.80$. The range error ratios varied from 4.5 to 16.0. Based on the results of external validation, the statistical tests and figures of merit, NIR spectroscopy proved to be useful for chemical prediction of banana and coffee residues and can be used as a faster and more economical alternative to the standard methodologies.

Rodriguez D., J. R. Cure, J. M. Cotes, A. P. Gutierrez, and F. Cantor. 2011. A coffee agroecosystem model: I. Growth and development of the coffee plant. *Ecological Modelling*, 222:3626-3639.

Reference ID: 22773

Notes: #22773e

Abstract: This paper is the first of three on the coffee production system consisting of (1) the coffee plant, (2) coffee berry borer (CBB) and (3) the role of CBB parasitoids. A previous simulation model of the coffee plant was developed using data from Brazil where coffee phenology is characterized by distinct seasonal flowering (Gutierrez et al., 1998). In contrast, flowering in Colombia is continuous with low seasonality. To capture the differences in coffee phenology and growth in the two climatic regions, the

Gutierrez et al. (1998) model was modified using new data from Colombia. The modifications to the model include:

- (1) The effect of solar radiation on floral buds initiation;
- (2) An age structure population model to track the daily input and development of the floral buds;
- (3) The effect of leaf water potential on breaking dormancy in flower buds, and hence on the timing and intensity of flowering;
- (4) The incorporation of both the vegetative and the reproductive demands to predict the photosynthetic rate.
- (5) The effect of low temperature on photosynthesis and defoliation.

Other aspects of the model were re-interpreted and refinements made to generalize its structure for use across coffee varieties and geographic areas. The model, without modification, realistically simulates field data from Brazil and two Colombian locations having different varieties, patterns of rainfall and hence flowering phenology. The model will be used as the base trophic level for incorporating CBB and high tropic levels effects, and for the analysis of management options in the coffee production system.

Tubino M. and J. R. D. Torres. 1992. Turbidimetric determination of potassium in leaf tissues with sodium tetraphenylboron. *Communications in Soil Science and Plant Analysis*, 23:123-128.

Reference ID: 22774

Notes: #22774e

Abstract: A turbidimetric method using sodium tetraphenylboron for the determination of potassium (K) in leaf tissues was investigated. Analysis of K was performed on soybean and coffee leaves. Results were compared with those obtained with flame photometry and a very good correlation was found. Using a spectrophotometer set at 420 nm and a 1.0-cm optical path cuvette, 1.0 µg/mL of K can be quantified. The method is recommended as an alternative to flame spectrophotometry.

Sakai E., E. A. A. Barbosa, J. M. D. Silveira, and R. C. D. Pires. 2015. Coffee productivity and root systems in cultivation schemes with different population arrangements and with and without drip irrigation. *Agricultural Water Management*, 148:16-23.

Reference ID: 22775

Notes: #22775e

Abstract: This study addressed the vegetative development, yield, and root development of coffee during cultivation in the absence and presence of drip irrigation and in different population arrangements over five years. A 6 x 2 factorial experimental scheme was used with a randomized block design and four replications. The six plantation densities were 1.60 x 0.50m; 1.60 x 0.75 m; 1.60 x 1.00 m; 3.20 x 0.50 m; 3.20 x 0.75 m; and 3.20 x 1.00 m. These plantation densities were divided into irrigated and non-irrigated treatments. The analysis of variance of the interaction between planting density and irrigation revealed absence of synergism in changing the biometric parameters. However, the isolated analysis of the factors showed significant effects of plantation densities, with the arrangement of 1.60 x 0.50 m getting the highest values of plant height and the smallest crown diameter, over the cycles. The adoption of irrigation caused significant effects on biometric parameters, with the irrigation of coffee causing increase in plant height, crown diameter and stalk diameter. The irrigated coffee in the four cycles resulted in a higher processed coffee production,

especially when coffee was grown with small row spacing. The irrigated coffee obtained the average yield of 2623 kg ha⁻¹, while the coffee without irrigation had an average yield of 1026 kg ha⁻¹. The irrigated treatments had greater root concentrations as compared to the non-irrigated treatments. In addition, the root concentration was greater in the 0-0.5-m layer when smaller row spacing was used.

Santos R., L. Rodrigues, C. Lima, and C. Jaramillo-Botero. 2012. Coffee Yield and Microenvironmental Factors in a Native Tree Agroforestry System in Southeast Minas Gerais, Brazil. *Journal of Sustainable Agriculture*, 36:54-68.

Reference ID: 22776

Notes: #22776e

Abstract: In Minas Gerais State, Brazil, some shade coffee production systems presented extremely low yield and have become economically unsustainable for family coffee farmers. In this study, coffee yield and microenvironmental factors in the agroforestry system were associated with tree species and the number of trees at different distances from the coffee shrubs. Forty coffee shrubs were marked, and concentric circles were established around each shrub at distances of 3 m, 5 m, and 7 m. The shade, litterfall, soil moisture, soil P content, and soil K content were determined near the coffee shrubs. Data were analyzed by path coefficient analyses. The number of individual *Schizolobium parahyba* trees between 0 and 3 m was positively correlated with soil P content, but this species was negatively correlated with coffee yield at all distances. The number of individual of *Senna macranthera* trees between 3 and 5 m was positively correlated with shading, which was positively correlated with soil moisture and, in turn, positively correlated with coffee yield. The results of this study suggested that growing individual *S. macranthera* trees between 3 and 5 m from coffee shrubs enhances coffee yield due to shading, which maintains soil moisture longer during the dry season.

Ngo H. T., A. C. Mojica, and L. Packer. 2011. Coffee plant - pollinator interactions: a review. *Canadian Journal of Zoology (Revue Canadienne de Zoologie)*, 89:647-660.

Reference ID: 22777

Notes: #22777e

Abstract: Coffee (genus *Coffea* L.) is one of the most critical global agricultural crops. Many studies have focused on coffee plants and their associated insects. This review will summarize work specifically relating to coffee plant - pollinator interactions. We review the current status of coffee as a worldwide commodity, botanical aspects of coffee, and insects associated with coffee pollination, and we assess the current understanding of the role of different pollinator taxa in increasing fruit set and yield.

Résumé: Le café (le genre *Coffea* L.) représente une des cultures agricoles globales les plus importantes. Plusieurs études se sont intéressées aux caféiers et aux insectes qui leur sont associés. Notre rétrospective résume les travaux reliés spécifiquement aux interactions caféiers-pollinisateurs. Nous examinons le statut actuel du café comme denrée mondiale, les aspects botaniques du café et les insectes associés à la pollinisation du café et nous évaluons la compréhension actuelle des rôles des différents taxons de pollinisateurs dans l'augmentation de la nouaison et du rendement.

Steiman S., T. Idol, H. C. Bittenbender, and L. Gautz. 2011. Shade coffee in Hawai'i - Exploring some aspects of quality, growth, yield and nutrition. *Scientia Horticulturae*, 128:152-158.

Reference ID: 22778

Notes: #22778e

Abstract: In a harsh (Kunia) and an ideal (Kona) growing region of Hawai'i, sun grown *Coffea arabica* L. was compared to coffee shaded with varying degrees of black and aluminized shade cloth, macadamia trees, and a novel, spray-on shade composed mostly of kaolin. Shading did not appreciably affect organoleptic quality. Shading resulted in statistically different yields in the macadamia (16% of sun) and kaolin (199% of sun) treatments in the second year compared to full sun treatments in their respective locations, although a negative, linear trend was observed with increased shading. The lack of significant differences in yields between the shade cloth and sun treatments was likely a result of large yield variation among replicates. Bean sizes differed little between shade treatments and the percentage of defects and broken beans were generally not significantly different among the treatments in Kunia. Kona bean sizes and characteristics were not different. Shading reduced surface leaf temperatures and increased specific leaf area but generally did not affect lateral nodal growth. Leaf nutrient concentration differed between treatments.

Lin B. B. 2009. Coffee (*Coffea arabica* var. Bourbon) Fruit Growth and Development Under Varying Shade Levels in the Soconusco Region of Chiapas, Mexico. *Journal of Sustainable Agriculture*, 33:51-65.

Reference ID: 22779

Notes: #22779e

Abstract: The belief that less shade cover will increase coffee production has encouraged farmers to reduce or eliminate shade trees from coffee agroforestry systems. However, this reduction in shade may alter environmental factors within coffee systems that may adversely affect fruit production in low-input systems. This will be especially detrimental in light of current climate change patterns in Southern Mexico. In this study, coffee fruit growth, fruit drop, and fruit weight were examined under two different levels of shade cover (high = 60% to 80% and medium = 30% to 50%) in low-input coffee farms of Chiapas, Mexico. Coffee berries were counted and measured throughout the 2005 growing season and weighed at harvest. Results showed that solar radiation, temperature, humidity, and soil moisture were correlated with fruit growth, all of which are environmental factors heavily controlled by shade cover. Fruit drop was highly correlated to both wind and soil moisture. Fruit weights were also highly correlated to soil moisture, but not significantly different between sites. Yield extrapolations calculated from site data showed little difference between the two sites, indicating that the high-shade site produced equally well to the medium-shade site. Future management for coffee agriculture should address the use of shade to maintain beneficial environmental factors for coffee production, since more highly shaded coffee systems are able to maintain productive environmental factors and high production rates.

Martinez H. E. P., R. B. Souza, J. A. Bayona, V. H. A. Venegas, and M. Sanz. 2003. Coffee-Tree Floral Analysis as a Mean of Nutritional Diagnosis. *Journal of Plant Nutrition*, 26:1467-1482.

Reference ID: 22780

Notes: #22780e

Abstract: Plant part analysis for evaluating the nutritional state of the crops is a practice commonly used. The analysis of flowers can allow an earlier diagnosis of nutritional deficiencies, excesses or unbalances, which facilitates its correction before the occurrence of irreversible losses in productivity and quality. The objective of this study were to determine the coffee tree (*Coffea arabica* L.) flower nutrients sufficiency ranges, to compare and correlate concentrations of nutrients observed in flowers and leaves collected 90 days after bloom, and to correlate the concentrations of nutrients in flowers and leaves with fruit yield. Samples of 26 experimental plots were collected. The plots were set up in nine different orchards five to nine years old and with 3000-5000 plants/ha, in the region of Vicoso, Minas Gerais State, Brazil. Eleven experimental plots were selected with mean yield greater than 7.0 kg/plant of coffee berry for the calculation of the nutrients sufficiency ranges. The concentrations of nitrogen (N), potassium (K), boron (B), iron (Fe), and zinc (Zn) were similar in flowers and leaves, whereas those of phosphorus (P), calcium (Ca), magnesium (Mg), sulfur (S), copper (Cu), and manganese (Mn) differed among the parts. There was correlation among the contents of N, Mg, Fe, Mn, Zn, and Cu in flowers and in leaves. For flowers a model of six variables and for leaves a model of eight variables explained 80% of the variation in the mean yield of the coffee tree plants. It is concluded that, flowers permit earlier diagnosis and greater precision in the diagnosis of the nutritional state of the coffee tree.

Wamatu J. N. and E. Thomas. 2001. A study of the ecological variability in yield of selected clones of Arabica coffee (*Coffea arabica* L.) from the coffee-breeding programme in Kenya. *Journal of Horticultural Science & Biotechnology*, 76:780-785.

Reference ID: 22781

Notes: #22781e

Abstract: Cherry yield of eleven elite clones of Arabica coffee was evaluated over a five-year period at three locations in a continuing study to determine the extent and influence of Clone X Environment interactions on coffee breeding lines developed in Kenya. Clone mean yield comparisons indicated a better performance of all the improved clones compared with the Standard. In analysis of variance (ANOVA) significant main effects and non-significant Clone X Environment interactions ($P < 0.05$) were found. Interactions were however, further investigated using ecovalence values, the Eberhart and Russell (1966) regression model as well as the Additive Main effects and Multiplicative Interaction effects (AMMI) model. The clones were then clustered according to their response patterns using principal components and cluster analyses to obtain a delineation of ecological districts and more accurate predictions of clone performance. The main effects for clones reflected breeding advances with the standard variety having the smallest mean. Improved materials from the hybridization scheme appeared to do better than their pure-line counterparts with clones 8, 3, 1 and 2 being the most advanced of the 11 clones. Similarly, the main effects for the environment reflected the overall site/year quality with Kiambu having the best production conditions particularly due to the favourable weather in 1983. This indicates that the coffee growing upper zone may be favourable for the clones especially when they are raised by top-working old coffee. Makuyu environments had the least interaction effects.

Guillaume T., A. M. Holtkamp, M. Damris, B. Brümmer, and Y. Kuzyakov. 2016. Soil degradation in oil palm and rubber plantations under land resource scarcity. *Agriculture, Ecosystems & Environment*, 232:110-118.

Reference ID: 22782

Notes: H 1.6 #22782e

Abstract: Tropical regions, such as Sumatra, experiencing extensive transformation of natural ecosystems, are close to complete exhaustion of available land. Agroecosystems strongly modify water and nutrient cycles, leading to losses of soil fertility, C sequestration and biodiversity. Although large companies are the main drivers of deforestation and plantation establishment, smallholders account for 40% of the oil palm and the majority of the rubber production in Indonesia. Here, we assess the extent and mechanisms of soil degradation under smallholder oil palm and rubber plantations in a context of land scarcity. The topsoil properties (C and N contents, C stocks, C/N ratio, bulk density) in 207 oil palm and rubber plantations in the Jambi province of Sumatra were determined beside trees, inside rows and interrows. Soils under oil palms were on average more degraded than under rubber, showing lower C content and stocks, lower N and higher bulk density. While soil properties were homogenous under rubber, two opposite trends were observed under oil palm plantations: the majority of soils had C content <2.2%, but about one fifth of the plantations had >9% C. This resulted from the establishment of oil palms under conditions of land scarcity. Because the oil palm boom started when rubber was already well-established, oil palms were frequently planted in marginal areas, such as peatlands or riparian areas (high C) or soils degraded by previous use (low C). The management of oil palms led to subsequent soil degradation, especially in interrows: C content decreased and bulk density increased in older oil palm plantations. This was not observed in rubber plantations because of a C input from leaf litter spread homogeneously all over the plantation, higher ground cover and a limited use of motorized vehicles. Considering that 10% of soils under oil palms had very low C content (<1%), we conclude that intensive cultivation can lead to intensive soil degradation and expect future degradation of soils under young oil palms. This challenges the sustainability of agricultural intensification in Sumatra. Because Sumatra is a pioneer of tropical land-use change, this should be regarded as potential threats that other tropical regions may face in future.

Motamayor J. C., A. M. Risterucci, P. A. Lopez, C. F. Ortiz, A. Moreno, and C. Lanaud. 2002. Cacao domestication I: the origin of the cacao cultivated by the Mayas. *Heredity*, 89:380-386.

Reference ID: 22783

Notes: H 8.1.4 #22783e

Abstract: Criollo cacao (*Theobroma cacao* ssp. *cacao*) was cultivated by the Mayas over 1500 years ago. It has been suggested that Criollo cacao originated in Central America and that it evolved independently from the cacao populations in the Amazon basin. Cacao populations from the Amazon basin are included in the second morphogeographic group: Forastero, and assigned to *T. cacao* ssp. *sphaerocarpum*. To gain further insight into the origin and genetic basis of Criollo cacao from Central America, RFLP and microsatellite analyses were performed on a sample that avoided mixing pure Criollo individuals with individuals classified as Criollo but which might have been introgressed with Forastero genes. We distinguished these two types of individuals as Ancient and Modern Criollo. In contrast to previous studies, Ancient Criollo individuals formerly classified as 'wild', were found to form a closely related group together with Ancient Criollo individuals from South America. The Ancient

Criollo trees were also closer to Colombian-Ecuadorian Forastero individuals than these Colombian-Ecuadorian trees were to other South American Forastero individuals. RFLP and microsatellite analyses revealed a high level of homozygosity and significantly low genetic diversity within the Ancient Criollo group. The results suggest that the Ancient Criollo individuals represent the original Criollo group. The results also implies that this group does not represent a separate subspecies and that it probably originated from a few individuals in South America that may have been spread by man within Central America.

Motamayor J. C., P. Lachenaud, J. W. da Silva e Mota, R. Loor, D. N. Kuhn, J. S. Brown, and R. J. Schnell. 2008. Geographic and Genetic Population Differentiation of the Amazonian Chocolate Tree (*Theobroma Cacao* L). Plos One, October:1-8.

Reference ID: 22784

Notes: H 8.1.4 #22684e

Abstract: Numerous collecting expeditions of *Theobroma cacao* L. germplasm have been undertaken in Latin-America. However, most of this germplasm has not contributed to cacao improvement because its relationship to cultivated selections was poorly understood. Germplasm labeling errors have impeded breeding and confounded the interpretation of diversity analyses. To improve the understanding of the origin, classification, and population differentiation within the species, 1241 accessions covering a large geographic sampling were genotyped with 106 microsatellite markers. After discarding mislabeled samples, 10 genetic clusters, as opposed to the two genetic groups traditionally recognized within *T. cacao*, were found by applying Bayesian statistics. This leads us to propose a new classification of the cacao germplasm that will enhance its management. The results also provide new insights into the diversification of Amazon species in general, with the pattern of differentiation of the populations studied supporting the palaeoarches hypothesis of species diversification. The origin of the traditional cacao cultivars is also enlightened in this study.

Loor Solorzano R. G., O. Fouet, A. Lemainque, S. Pavék, M. Boccara, X. Argout, F. Amores, B. Courtois, A. M. Risterucci, and C. Lanaud. 2012. Insight into the Wild Origin, Migration and Domestication History of the Fine Flavour Nacional *Theobroma cacao* L. Variety from Ecuador. Plos One, November:1-11.

Reference ID: 22785

Notes: H 8.1.4 #22785e

Abstract: Ecuador's economic history has been closely linked to *Theobroma cacao* L. cultivation, and specifically to the native fine flavour Nacional cocoa variety. The original Nacional cocoa trees are presently in danger of extinction due to foreign germplasm introductions. In a previous work, a few non-introgressed Nacional types were identified as potential founders of the modern Ecuadorian cocoa population, but so far their origin could not be formally identified. In order to determine the putative centre of origin of Nacional and trace its domestication history, we used 80 simple sequence repeat (SSR) markers to analyse the relationships between these potential Nacional founders and 169 wild and cultivated cocoa accessions from South and Central America. The highest genetic similarity was observed between the Nacional pool and some wild genotypes from the southern Amazonian region of Ecuador, sampled along the Yacuambi, Nangaritza and Zamora rivers in Zamora Chinchipe province. This result was confirmed by a parentage analysis. Based on our results and on data about pre-Columbian civilization and Spanish colonization history of Ecuador, we determined, for the first time, the possible centre of origin and migration events of

the Nacional variety from the Amazonian area until its arrival in the coastal provinces. As large unexplored forest areas still exist in the southern part of the Ecuadorian Amazonian region, our findings could provide clues as to where precious new genetic resources could be collected, and subsequently used to improve the flavour and disease resistance of modern Ecuadorian cocoa varieties.

Loor R. G., A. M. Risterucci, B. Courtois, O. Fouet, M. Jeanneau, E. Rosenquist, F. Amores, A. Vasco, M. Medina, and C. Lanaud. 2009. Tracing the native ancestors of the modern *Theobroma cacao* L. population in Ecuador. *Tree Genetics & Genomes*, 5:421-433.

Reference ID: 22786

Notes: H 8.1.4 #22786e

Abstract: The native *Theobroma cacao* L. population from Ecuador, known as Nacional, is famous for its fine cocoa flavour. From the beginning of the twentieth century, however, it has been subjected to genetic erosion due principally to successive introductions of foreign germplasm whose hybrid descendants gradually replaced the native plantations, implying a decrease in cocoa quality. We attempted to trace this native cacao within a wide pool of modern Ecuadorian cacao population. Three hundred and twenty-two cacao accessions collected from different geographical areas along the pacific coast of Ecuador and maintained in two living collections were analysed using 40 simple-sequence repeat markers. Most of Ecuadorian cacao accessions displayed a high density and heterozygosity level. A factorial analysis of correspondence (FAC) showed a continuous variation among them, with a few ones, grouped at an extreme side of the FAC cloud, showing higher levels of homozygosity and lower introgression level by foreign cacaos. A paternity analysis revealed that these highly homozygous individuals are the most probably ancestors of the modern Nacional hybrid pool. These particular accessions studied could represent the native Nacional cacao present in Ecuador before the foreign introductions. Their identification will help to conserve valuable genetic material and to improve cocoa quality in new cacao varieties.

Gu F., L. Tan, H. Wu, Y. Fang, F. Xu, Z. Chu, and Q. Wang. 2013. Comparison of Cocoa Beans from China, Indonesia and Papua New Guinea. *Foods*, 2:183-197.

Reference ID: 22787

Notes: H 8.1.4 #22787e

Abstract: A survey on five kinds of cocoa beans from new cocoa planting countries was conducted to analyze each kind's basic quality. The average bean weight and butter content of Hainan cocoa beans were the lowest, at less than 1.1 g, and 39.24% to 43.44%, respectively. Cocoa beans from Indonesia were shown to be about 8.0% and 9.0% higher in average bean weight and butter content, respectively, than that of Papua New Guinea and about 20.0% and 25.0% higher in average bean weight and butter content than Chinese dried beans, respectively. The average total polyphenolic content ranged from 81.22 mg/10 g to 301.01 mg/10 g. The Hainan 2011 sample had the highest total polyphenolic content, followed by the unfermented sample from Indonesia and the Papua New Guinea sample. The polyphenolic levels found in the Hainan 2010 sample were 123.61 mg/10 g and lower than the other three samples, but the Indonesian fermented sample had the lowest total polyphenolic content of 81.22 mg/10 g. The average total amino acid content ranged from 11.58 g/100 g to 18.17 g/100 g. The total amino acid content was the highest in the Indonesian unfermented sample, followed by the Hainan 2011 sample and the Papua New Guinea

sample. The levels found in the Hainan 2010 sample were lower; the Indonesian fermented sample had the lowest total amino acid content.

Yanus R. L., H. Sela, E. J. C. Borojovich, M. Saphier, A. Nikolski, E. Gutflais, A. Lorber, and Z. Karpas. 2014. Trace elements in cocoa solids and chocolate: An ICPMS study. *Talanta*, 119:1-4.

Reference ID: 22788

Notes: H 8.1.4 #22788e

Abstract: The concentrations of eight trace elements: lead (Pb), cadmium (Cd), chromium (Cr), manganese (Mn), cobalt (Co), arsenic (As), bismuth (Bi) and molybdenum (Mo), in chocolate, cocoa beans and products were studied by ICPMS. The study examined chocolate samples from different brands and countries with different concentrations of cocoa solids from each brand. The samples were digested and filtered to remove lipids and indium was used as an internal standard to correct matrix effects. A linear correlation was found between the level of several trace elements in chocolate and the cocoa solids content. Significant levels of Bi and As were found in the cocoa bean shells but not in the cocoa bean and chocolate. This may be attributed to environmental contamination. The presence of other elements was attributed to the manufacturing processes of cocoa and chocolate products. Children, who are big consumers of chocolates, may be at risk of exceeding the daily limit of lead; whereas one 10 g cube of dark chocolate may contain as much as 20% of the daily lead oral limit. Moreover chocolate may not be the only source of lead in their nutrition. For adults there is almost no risk of exceeding daily limits for trace metals ingestion because their digestive absorption of metals is very poor.

Ruf F., Jamaluddin, Yoddang, and W. Ardhy. 1995. The "Spectacular" Efficiency of Cocoa Smallholders in Sulawesi: Why? Until When? Pages 339-375 *in* Fe Ruf and PS Siswoputranto, editors. *Cocoa Cycles: The Economics of Cocoa Supply*. Woodhead Publishing Ltd, New Delhi.

Reference ID: 22789

Notes: #22789e > S 8.1.4 #20693

Abstract: Using the term "spectacular to describe the efficiency of Sulawesi's cocoa farmers requires answers to a number of questions. How is this efficiency appraised? In which fields is it exerted - economics, social or political? With whom might these Sulawesi family smallholdings be compared? Can they be compared fairly with private estates in the same country or a neighbouring country like Malaysia? Should they be compared with similar planters in Africa - the hundreds of thousands of cocoa growers in Cote d'Ivoire or Ghana? Or should Sulawesi's cocoa farmers be compared strictly with other Indonesian producers? How does the efficiency of cocoa planters measure up to the efficiency of other actors in the export sector who are similar targets of state agricultural policies and intervention?

Teixeira P. J. P. L., D. P. dT. Thomazella, and G. A. G. Pereira. 2015. Time for Chocolate: Current Understand and New Perspectives on Cacao Witches' Broom Disease Research. *Plos Pathogens*, 11:1-8.

Reference ID: 22790

Notes: #22790e

Abstract: *Theobroma cacao* is a tropical understory tree that is one of the most important perennial crops in agriculture. Treasured by ancient civilizations in Mesoamerica for over 3,000 years, the cocoa bean now supports a multibillion-dollar industry that is involved in the production and commercialization of chocolate, a treat

appreciated worldwide. The cacao tree is originally from the Amazon rainforest and is currently grown in more than 50 countries throughout the humid tropics, serving as a major source of income for over 40 million people. Each year, more than 3 million tons of cocoa beans are produced, mostly by smallholder farmers in areas of high biodiversity. Notably, the cacao tree does not require direct sunlight and naturally grows under the canopy of other, taller trees. This characteristic often encourages farmers to preserve existing forests and to plant additional trees to shelter their cacao plants [1], thereby reducing the environmental impacts of cacao cultivation. Despite its great importance, the cacao tree is affected by a number of untreatable diseases that reduce fruit production and threaten our global supply of cacao. Among them, witches' broom disease (WBD) stands out as one of the most severe problems that affect this crop, accounting for production losses of up to 90%.

Manton, W. I. Sources of Lead in Cocoa and Chocolate: Response 1. *Environmental Health Perspective* 114[5], 274-275. 2006.

Reference ID: 22791

Notes: #22791e

Abstract: The article "Lead Contamination in Cocoa and Cocoa Products: Isotopic Evidence of Global Contamination" (Rankin et al. 2005) has attracted international attention (crienglish.com2005) because of an interview that Rankin granted a reporter from Science News (Raloff 2005). Raloff's report makes it generally known that Rankin et al.'s study was commissioned by the American Environmental Safety Institute (AESI).

Rankin, C. W. and Flegal, A. R. Lead in Cocoa and Chocolate: Rankin and Flegal Respond. *Environmental Health Perspective* 114[5], 2. 2006.

Reference ID: 22792

Notes: #22792e

Abstract: We thank Manson for his comments on our study (Rankin et al 2005), and we hope that readers will be encouraged to read the entire article to place his correspondence in perspective. In our article (Rankin et al 2005), we documented the orders of magnitude of increases in lead concentration of processed cocoa and chocolate products over that of the lead concentration in cocoa bean nibs used in the manufactures of those products. We maintain that our conclusions are substantiated by both the data and the extensive literature documenting industrial lead contamination in biosphere (Cocoa Production Alliance 2004: National Research Council 1993).

Bisseleua H. B. D., D. Fotio, Yede, A. D. Missoup, and S. Vidal. 2013. Shade Tree Diversity, Cocoa Pest Damage, Yield Compensating Inputs and Farmers' Net Returns in West Africa. *Plos One*, 8:1-9.

Reference ID: 22793

Notes: #22793e

Abstract: Cocoa agroforests can significantly support biodiversity, yet intensification of farming practices is degrading agroforestry habitats and compromising ecosystem services such as biological pest control. Effective conservation strategies depend on the type of relationship between agricultural matrix, biodiversity and ecosystem services, but to date the shape of this relationship is unknown. We linked shade index calculated from eight vegetation variables, with insect pests and beneficial insects (ants, wasps and spiders) in 20 cocoa agroforests differing in woody and herbaceous

vegetation diversity. We measured herbivory and predatory rates, and quantified resulting increases in cocoa yield and net returns. We found that number of spider webs and wasp nests significantly decreased with increasing density of exotic shade tree species. Greater species richness of native shade tree species was associated with a higher number of wasp nests and spider webs while species richness of understory plants did not have a strong impact on these beneficial species. Species richness of ants, wasp nests and spider webs peaked at higher levels of plant species richness. The number of herbivore species (mirid bugs and cocoa pod borers) and the rate of herbivory on cocoa pods decreased with increasing shade index. Shade index was negatively related to yield, with yield significantly higher at shade and herb covers < 50%. However, higher inputs in the cocoa farms do not necessarily result in a higher net return. In conclusion, our study shows the importance of a diverse shade canopy in reducing damage caused by cocoa pests. It also highlights the importance of conservation initiatives in tropical agroforestry landscapes.

Fassbender H. W., L. Alpizar, J. Heuvelop, and G. Enriquez. 1988. Modelling agroforestry systems of cacao (*Theobroma cacao*) with laurel (*Cordia alliodora*) and poro (*Erythrina poeppigiana*) in Costa Rica III. Cycles of organic matter and nutrients. *Agroforestry Systems*, 6:49-62.

Reference ID: 22794

Notes: H 8.1.4.1 #22794e

Abstract: Models for cycles for organic matter and nutrients element (N, P, K, Ca and Mg) are presented for the agroforestry systems of cacao (*Theobroma cacao*) with *Cordia alliodora* or *Erythrina poeppigiana* in Turrialba, Costa Rica. For the models, system reserves (soil, humus, vegetation divided into leaves, branches, stems, fine roots, fruits) and transference between compartments (production and decomposition of litter residues) inputs (fertilizer, rainfall) and outputs (harvests) of the system are considered.

The implications of the models are discussed in detail. Aspects of net primary production in the systems studied are considered. N fixation is calculated on the basis of balances. Analysis of soil water showed high variations that coincided with rainfall patterns and pruning of the *E. poeppigiana*.

Heuvelop J., H. W. Fassbender, G. Enriquez, and H. Fölster. 1988. Modelling agroforestry systems of cacao (*Theobroma cacao*) with laurel (*Cordia alliodora*) and poro (*Erythrina poeppigiana*) in Costa Rica II. Cacao and wood production, litter production and decomposition. *Agroforestry Systems*, 6:37-38.

Reference ID: 22795

Notes: H 8.1.4.1 #22795e

Abstract: During 7 years (1979-1985) cacao harvests (beans and husks) have been recorded for the agroforestry systems of *Theobroma cacao* under *Cordia alliodora* and *Erythrina poeppigiana* shade trees. The mean oven dry cacao yields were 626 and 712 kg.ha⁻¹.a⁻¹ cocoa beans under *C. alliodora* and *E. poeppigiana* respectively. Harvests have gradually increased over the years and the plantation has now reached maturity.

Annual extraction of N, P, K, Ca and Mg in fruits, which is relatively small, was calculated on the basis of chemical analyses.

At the age of 8 years, the *C. alliodora* trees have reached 26.7 cm diameter (DBH) and 14.0 m in height. Mean annual growth (from age 5 to 7) is 14.6 m³.ha⁻¹.a⁻¹. Natural plant residue production has been measured for 4 years (Nov. 1981-Oct. 1985). Under *E. poeppigiana* it has reached a value of 8.91 t.ha⁻¹.a⁻¹ and under *C.*

alliodora 7.07 t.ha⁻¹.a⁻¹. The shade trees have contributed 57 and 47% respectively. Transference and decomposition rates are high and important in the nutrient cycles.

Alpizar L., H. W. Fassbender, J. Heuvelop, H. Folster, and G. Enriquez. 1986. Modelling agroforestry systems of cacao (*Theobroma cacao*) with laurel (*Cordia alliodora*) and poro (*Erythrina poeppigiana*) in Costa Rica I. Inventory of organic matter and nutrients. *Agroforestry Systems*, 4:175-189.

Reference ID: 22796

Notes: H 8.1.4.1 #22796e

Abstract: The agroforestry systems of cacao (*Theobroma cacao*) under laurel (*Cordia alliodora*) and cacao under poro (*Erythrina poeppigiana*) were studied at CATIE, Turrialba, Costa Rica. An inventory was taken of the organic matter and nutrients (N, P, K, Ca, and Mg) separating the species into their compartments (leaves, branches, trunks and roots). Patterns of nutrient accumulation are discussed in relation to the characteristics of these agroforestry systems.

Denkyirah E. K., E. D. Okoffo, D. T. Adu, A. A. Aziz, A. Ofori, and E. K. Denkyirah. 2016. Modeling Ghanaian cocoa farmers' decision to use pesticide and frequency of application: the case of Brong Ahafo Region. *SpringerPlus*, 5:1-17.

Reference ID: 22797

Notes: #22797e

Abstract: Pesticides are a significant component of the modern agricultural technology that has been widely adopted across the globe to control pests, diseases, weeds and other plant pathogens, in an effort to reduce or eliminate yield losses and maintain high product quality. Although pesticides are said to be toxic and exposes farmers to risk due to the hazardous effects of these chemicals, pesticide use among cocoa farmers in Ghana is still high. Furthermore, cocoa farmers do not apply pesticide on their cocoa farms at the recommended frequency of application. In view of this, the study assessed the factors influencing cocoa farmers' decision to use pesticide and frequency of pesticide application. A total of 240 cocoa farmers from six cocoa growing communities in the Brong Ahafo Region of Ghana were selected for the study using the multi-stage sampling technique. The Probit and Tobit regression models were used to estimate factors influencing farmers' decision to use pesticide and frequency of pesticide application, respectively. Results of the study revealed that the use of pesticide is still high among farmers in the Region and that cocoa farmers do not follow the Ghana Cocoa Board recommended frequency of pesticide application. In addition, cocoa farmers in the study area were found to be using both Ghana Cocoa Board approved/recommended and unapproved pesticides for cocoa production. Gender, age, educational level, years of farming experience, access to extension service, availability of agrochemical shop and access to credit significantly influenced farmers' decision to use pesticides. Also, educational level, years of farming experience, membership of farmer based organisation, access to extension service, access to credit and cocoa income significantly influenced frequency of pesticide application. Since access to extension service is one key factor that reduces pesticide use and frequency of application among cocoa farmers, it is recommended that policies by government and non-governmental organisations should be aimed at mobilizing resources towards the expansion of extension education. In addition, extension service should target younger farmers as well as provide information on alternative pest control methods in order to reduce pesticide use among cocoa farmers. Furthermore, extension service/agents should target cocoa farmers with less years of

farming experience and encourage cocoa farmers to join farmer based organisations in order to decrease frequency of pesticide application.

Anonymous. InfoSawit Vol X No 6 Juni 2016. Infosawit 10[6], 1-56. 2016. Indonesia.

Reference ID: 22798

Notes: #22798e

Anonymous. InfoSawit Vol X No 7 Juli 2016. Infosawit 10[7], 1-56. 2016. Indonesia.

Reference ID: 22799

Notes: #22799e

Taylor, D. A. Lead in Cocoa Products: Where Does Contamination Come From? Environmental Health Perspective 113[10], 687-688. 2005.

Reference ID: 22800

Notes: #22800e

Abstract: Manufactured cocoa products frequently have higher lead concentrations than other foods, even though cocoa beans, the main ingredient, have some of the lowest reported lead levels for any natural food. In 2001, the Codex Alimentarius Commission, an international body based in Rome, proposed reducing the maximum permissible level of lead in cocoa products by half, to 100 nanogram per gram (ng/g) for cocoa butter and 1,000 ng/g for cocoa powder. At a March 2002 meeting in West Africa, where most of the world's cocoa supply originates, producers agreed that to reduce lead in their products, they needed research to identify the source of contamination. Now a U.S.-Nigerian research team has uncovered some of the first clues about where the lead is coming from.

USAID. Indonesia Cocoa Bean Value Chain Case Study: microREPORT #65. 1-16. 2006.

Reference ID: 22801

Notes: #22801e

Abstract: Indonesia is the third largest producer of cocoa in the world after Ghana and the Ivory Coast, and the most significant cocoa bean supplier in East Asia. Indonesia's biggest competitive advantages include its low cost, high production capacity (availability of supply), efficient infrastructure and open trading/marketing system (business environment).

Although the cocoa value chain in Indonesia has experienced phenomenal growth over the past few decades, its continued competitiveness is threatened by inconsistent and poor quality production. Widespread pest infestation, especially from the cocoa pod borer (CPB), is a primary cause of poor cocoa bean quality. In order to address the problems of CPB infestation, various public and private sector initiatives have been undertaken to conduct research, train and improve the traditional practices of smallholder cocoa farmers in Indonesia. Despite these efforts, adoption of improved production and post harvest skills by cocoa farmers has been limited.

Hurvich C. M., J. S. Simonoff, and C.-L. Tsai. 1998. Smoothing Parameter Selection in Nonparametric Regression Using an Improved Akaike Information Criterion. Journal of the Royal Statistical Society, 60:271-293.

Reference ID: 22802

Notes: #22802e

Abstract: Summary. Many different methods have been proposed to construct nonparametric estimates of a smooth regression function, including local polynomial,

(convolution) kernel and smoothing spline estimators. Each of these estimators uses a smoothing parameter to control the amount of smoothing performed on a given data set. In this paper an improved version of a criterion based on the Akaike information criterion (AIC), termed AICc, is derived and examined as a way to choose the smoothing parameter. Unlike plug-in methods, AICc can be used to choose smoothing parameters for any linear smoother, including local quadratic and smoothing spline estimators. The use of AICc avoids the large variability and tendency to undersmooth (compared with the actual minimizer of average squared error) seen when other 'classical' approaches (such as generalized cross-validation or the AIC) are used to choose the smoothing parameter. Monte Carlo simulations demonstrate that the AICc based smoothing parameter is competitive with a plug-in method (assuming that one exists) when the plug-in method works well but also performs well when the plug-in approach fails or is unavailable.

van Straaten O., M. D. Corre, K. Wolf, M. Tchienkoua, E. Cuellar, R. B. Matthews, and E. Veldkamp. 2015. Conversion of lowland tropical forests to tree cash crop plantations loses up to one-half of stored soil organic carbon. *PNAS*, 112:9956-9960.

Reference ID: 22803

Notes: #22803e

Abstract: Tropical deforestation for the establishment of tree cash crop plantations causes significant alterations to soil organic carbon (SOC) dynamics. Despite this recognition, the current Intergovernmental Panel on Climate Change (IPCC) tier 1 method has a SOC change factor of 1 (no SOC loss) for conversion of forests to perennial tree crops, because of scarcity of SOC data. In this pantropic study, conducted in active deforestation regions of Indonesia, Cameroon, and Peru, we quantified the impact of forest conversion to oil palm (*Elaeis guineensis*), rubber (*Hevea brasiliensis*), and cacao (*Theobroma cacao*) agroforestry plantations on SOC stocks within 3-m depth in deeply weathered mineral soils. We also investigated the underlying biophysical controls regulating SOC stock changes. Using a space-for-time substitution approach, we compared SOC stocks from paired forests ($n = 32$) and adjacent plantations ($n = 54$). Our study showed that deforestation for tree plantations decreased SOC stocks by up to 50%. The key variable that predicted SOC changes across plantations was the amount of SOC present in the forest before conversion—the higher the initial SOC, the higher the loss. Decreases in SOC stocks were most pronounced in the topsoil, although older plantations showed considerable SOC losses below 1-m depth. Our results suggest that (i) the IPCC tier 1 method should be revised from its current SOC change factor of 1 to 0.6 ± 0.1 for oil palm and cacao agroforestry plantations and 0.8 ± 0.3 for rubber plantations in the humid tropics; and (ii) land use management policies should protect natural forests on carbon-rich mineral soils to minimize SOC losses.

Sitorus M. T. F. 2002. *Revolusi Cokelat: Social Formation, Agrarian Structure and Forest Margins in Upland Sulawesi, Indonesia*. Pages 1-20.

Reference ID: 22804

Notes: #22804e

Abstract: This paper examines the sociological implications of a fundamentally rapid change in rural ecology due to the rapid expansion of cocoa cultivation which is labeled as "Revolusi Cokelat" (cocoa revolution). As exemplified by the case of Sintuwu, a village in upland Sulawesi, such a revolution implies a radical change of local social formation, indicated by the shift of the dominant mode of production from subsistence production, which was domain of the "indigenous people" (the Kaili), to the petty

commodity (capitalist) one, which is the domain of mainly the "corner people" (the Bugis). Consequently, the revolution implies the fundamental change of the local agrarian structure through which the Kaili people have been downgraded from "landed" to "landless", while the Bugis have been upgraded from "landless" to "landed". Moreover, as the cocoa plantation becomes the main base of socio-economic security, such a change in the agrarian structure implies both the decrease of socio-economic security among the Kaili and the increase of such security of the Bugis. This condition has led the Kaili peoples to solve the socio-economic insecurity by encroaching on the forest margin inside of the Lore Lindu National Park as an alternative basis of socio-economic security. By reclaiming the forest area and covering it with cocoa plantation, the Kaili peoples, to some extent, have succeeded in overcoming the problem of access to land resource as well as the problem of socio-economic security.

Goenaga R., M. Gultinan, S. Maximova, E. Seguíne, and H. Irizarry. 2015. Yield Performance and Bean Quality Traits of Cacao Propagated by Grafting and Somatic Embryo-derived Cuttings. *HortScience*, 50:358-362.

Reference ID: 22805

Notes: #22805e

Abstract: Twelve cacao (*Theobroma cacao*) clones propagated by grafting and orthotropic rooted cuttings of somatic embryo-derived plants were grown on an Ultisol soil at Corozal, Puerto Rico, and evaluated for 6 years of production under intensive management. Year, variety, year × variety, and propagation treatment × variety interactions indicated significant effects for dry bean yield, number of pods produced, pod index, plant height, and stem diameter. Propagation treatments had a significant effect on dry bean yield and pod index but not on number of pods produced. Average yield across varieties for both propagation treatments was 2087.9 kg·ha⁻¹ per year of dry beans. There was a highly significant variety effect. 'UF-668' was the top yielder averaging 2536.7 kg·ha⁻¹ per year of dry beans; however, this yield was not significantly different from the average yield of varieties 'TARS-30', 'TARS-1', 'TARS-13', 'TARS-14', and 'TARS-2', which averaged 2427.0 kg·ha⁻¹ per year. Except for 'UF-668', the TARS varieties were released in 2009 as high-yielding selections. Propagation treatments had a significant effect on dry bean yield. Dry bean yield of varieties propagated by grafting was 7% higher (2166.7 kg·ha⁻¹ per year) than those propagated by orthotropic rooted cuttings of somatic embryo-derived plants (2009.2 kg·ha⁻¹ per year). This yield difference could not be attributed to grafted plants being more vigorous nor by differences in root architecture. The lowest pod index value in both propagation treatments was obtained by 'UF-668'; however, pod index for this variety did not differ significantly from values for 'TARS-2' and 'TARS-23' in grafted plants and from 'TARS-2', 'TARS-23', and 'TARS-1' in plants propagated by orthotropic rooted cuttings of somatic embryo-derived plants. With few exceptions, flavor characteristics were not significantly affected by propagation treatments. Although there were significant differences between plant propagation treatments for some of the variables measured in this study, these were not of a magnitude that would preclude the use of somatic embryogenesis as a viable propagation system for cacao.

Olu-Owolabi B. I., F. O. Agunblade, B. O. Fagbayigbo, and K. O. Adebawale. 2013. Monitoring Copper Bioaccumulation in Cocoa from Copper-Based Pesticide-Treated Cocoa Farms Using Fuzzy Similarity Method. *Bioremediation Journal*, 17:131-147.

Reference ID: 22806

Notes: #22806e

Abstract: Cocoa production has been hindered by pests, leading to application of pesticides. These pesticide applications have raised health concerns. This study is therefore aimed at developing accumulation classifications for copper (Cu) in cocoa from plantations where Cu-based pesticides have been applied using fuzzy similarity method (FSM). Cocoa pods, seeds, leaves, and soil samples were collected from five different plantations from three states in Nigeria. The plant samples were digested using standard methods, whereas the Cu in soil samples was extracted with 1 M ammonium acetate. The products were analyzed for Cu using flame atomic absorption spectrophotometer. The Cu concentrations obtained were used to model the accumulation degree using FSM. The Cu concentrations were higher in the leaves than the seeds and the pods. The persistency of Cu was displayed by high concentrations (11.5–375 mg/kg) and enrichment factor in CRIN sites where this pesticide application has been stopped for over a decade. The leaves from Ondo sites had the highest Cu concentration, which indicates impact of recent applications. The FSM membership function and algorithm indicated that the plant parts had low degrees of accumulation for fresh leaves, pods, and seeds, the valued part applied in beverages, but for the dry leaves, the accumulation degree is high. It may be concluded that the applied Cu-based pesticide had more impact and accumulation on the leaves than the commercial valued seeds, but the Cu concentration in the seeds is above the recommended value.

Erhabor J. O. and G. C. Filson. 1999. Soil Fertility Changes Under an Oil Palm-Based Intercropping System. *Journal of Sustainable Agriculture*, 14:45-61.

Reference ID: 22807

Notes: H 8.1.1.8 #22807e

Abstract: Published information on nutrient dynamics in relation to soil fertility management for oil palm-based cropping systems is still scarce in Nigeria. An intercropping experiment with oil palm (*Elaeis guineensis* Jacq), soybean (*Glycine max*), maize (*Zea mays*) and coco-yam (*Xanthosoma sagittifolium*) was therefore conducted from 1992–1994 to evaluate changes in soil nutrient levels. The experimental design was a randomised complete block with three replicates. Treatments consisted of: (A) sole oil palm; (B) sole soybean; (C) sole maize; (D) sole cocoyam; (E) oil palm + soybean; (F) oil palm + maize; (G) oil palm + cocoyam; (H) oil palm + soybean + maize; (I) oil palm + soybean + cocoyam; (J) oil palm + soybean + maize + cocoyam. A pre-cropping composite soil sample was taken at a depth of 0–30 cm in 1992. Soil sampling for analysis was conducted on plot basis after harvesting for soil pH, organic matter, total nitrogen, available P and exchangeable K, Mg and Ca.

There was no significant change in pH after 3 cropping years, but soil organic matter declined from 10–51% in treatments G and I. The decline in total N ranged from 50–70% in treatments A and J. At the end of the experiment the P level increased up to 71% in treatment E. Exchangeable K declined from 32 to 62% in treatment F and H, respectively. The observed decline in N and K could be due to crop removal and leaching. No significant changes were observed for Ca and Mg. Intercropping depressed the sex ratio in oil palm by between 6 and 17%. Soybean seed yield was highest (1.5 t ha⁻¹) in the sole plot and lowest (0.7t ha⁻¹) in soybean + oil palm + maize + cocoyam. Grain yields from sole maize and maize intercropped with oil palm were superior to yields from the other intercropping treatments. A similar trend was observed for cocoyam corm yield. The significance of this finding for sustainable agriculture is that intercropping encourages the maximization of land

use, stability in yield and profit. Furthermore, intercropping of cereal with grains provides balanced energy and protein diets for farm families.

Kavino M., S. Harish, N. Kumar, D. Saravanakumar, and R. Samiyappan. 2010. Effect of chitinolytic PGPR on growth, yield and physiological attributes of banana (*Musa spp.*) under field conditions. *Applied Soil Ecology*, 45:71-77.

Reference ID: 22808

Notes: H 8.6.2 #22808e

Abstract: Plant growth promoting effects of two *Pseudomonas fluorescens* strains, CHA0 and Pf1 were tested alone or in combinations with chitin on banana cv. Virupakshi (*Musa spp.* AAB) in terms of growth, yield, leaf nutrient contents and physiology in lower Pulney hills, Western Ghats, India under rainfed field conditions. The *P. fluorescens* strains, CHA0 and Pf1 were tested for their efficiency to produce chitinases in the presence of chitin molecules. Bio-formulations containing PGPR strains and chitin molecules were further developed to improve the chitinolytic activity of the rhizobacteria. The bio-formulations amended with chitin, viz., CHA0 + chitin significantly increased the height and girth of pseudostem, bunch yield, number of hands per bunch, fingers per hand and quality attributes compared to other treatments both in plant as well as ratoon crops. Further, the application of CHA0 + chitin significantly improved the N, P and K contents of banana leaves when compared to untreated control. These results revealed that *P. fluorescens* strain, CHA0 in combination with chitin has the potential to increase growth, leaf nutrient contents and yield of banana plants under perennial cropping systems. In view of environmental pollution, due to excessive use and high production costs of fertilizers, PGPR strains tested in our study have a potential to be used for sustainable and environmentally friendly horticultural production.

Mahouachi J. 2007. Growth and mineral nutrient content of developing fruit on banana plants (*Musa acuminata* AAA, 'Grand Nain') subjected to water stress and recovery. *Journal of Horticultural Science and Biotechnology*, 82:834-844.

Reference ID: 22809

Notes: H 8.6.2.1 #22809e

Abstract: The effects of progressive water stress and subsequent re-hydration on fruit growth and mineral nutrient content were investigated in banana plants (*Musa acuminata* AAA, 'Grand Nain') under field conditions. Water stress was imposed by suspending irrigation from flower emergence for 63 d, then continuous re-watering was restored. These adverse conditions reduced fruit growth, fruit size, yield, and delayed fruit maturation. Fruit fresh and dry weights decreased with photosynthetic rate and soil moisture content during the stress period. In relation to nutrient accumulation, the main effect of drought was to reduce potassium levels, which is the major mineral nutrient in banana. In contrast, all the other minerals analysed either increased (i.e., calcium, sodium, iron and zinc), or remained stable (i.e., nitrogen, phosphorus, magnesium, manganese and copper) under the drought treatment, which generated a positive effect on the organoleptic properties of the fruit. After re-hydration, the mineral nutrient content of banana fruit was similar between stressed and non-stressed plants. The data illustrate the ability of banana to maintain relatively normal mineral contents and functional fruit tissues, which continued to expand after re-hydration, despite the long period of water stress. However, banana fruit lost commercial value, with a reduction in size and biomass after the water stress period.

Keshavan G., M. Kavino, and V. Ponnuswami. 2011. Influence of different nitrogen sources and levels on yield and quality of banana (*Musa spp.*). Archives of Agronomy and Soil Science, 57:305-315.

Reference ID: 22810

Notes: H 8.6.2.1 #22810e

Abstract: Banana requires heavy manuring for its optimum growth and better fruiting. A field experiment was conducted to gain information on the efficacy of different sources of nitrogen on yield and quality of banana. The results revealed that among the various treatments, 25% nitrogen (N) as calcium ammonium nitrate (CAN) + 25% N as urea (U) + 50% N as ammonium sulphate (AS) followed by 25% N as CAN + 50% N as U + 25% of N as AS recorded better values for growth characteristics. Similarly, maximum values for yield parameters were recorded in the same treatments. Higher values for total soluble solids (TSS) and total sugars with least acidity besides better physiological parameters with high available soil and leaf nutrient contents were recorded when mixtures of CAN, U and AS applied as N sources to the plants. Hence, the application of required nitrogenous fertilizer as a mixture of different N sources registered better values in terms of growth, yield, physiological parameters, leaf nutrient contents and quality characters rather than applied as a single source of N.

Hillocks R. J. 2000. Integrated crop management for smallholder farmers in Africa with special reference to coffee in Malawi. Pest Management Science, 56:963-968.

Reference ID: 22811

Notes: #22811e

Abstract: Integrated crop management (ICM) goes beyond integrated pest management (IPM) in taking a more holistic approach that incorporates crop protection activities as an aspect of crop husbandry and as part of the overall farm management plan. This encourages farmers to consider the pest management benefits of sound crop husbandry and soil nutrient management, so that the use of commercial pesticides is a last resort, but when their use is necessary it is fully integrated with cultural practices. Viewed in this way, ICM has much to offer agriculture in Africa, which is still largely based on smallholdings. However, the ICM concept as it is applied in developed countries will require careful adaptation to the needs of smallholder agriculture in the developing world. The most significant difference between the two levels of agrarian development is that in Western Europe and to some extent North America, food production is in surplus, whereas in Africa the need is still to maximise food production per hectare. Environmental concerns cannot therefore be a central component of an ICM system that will be acceptable to an African smallholder. The first requirement if ICM is to be adopted in Africa is that it should deliver yield increases and also that the crop production increases are sustainable. Practices that pollute the environment or deplete the resource base are not ICM-compatible. Smallholder coffee in Malawi is taken as a case study to illustrate the contribution that an ICM approach could make to sustainable increases in crop production.

Mburu Njoroge J. and E. Mwakha. 1992. Influence of Nitrogen Fertilizer and Plant Density on Growth and Yield of Arabica Coffee During the First Production Cycle in Kenya. East African Agricultural and Forestry Journal, 58:1-11.

Reference ID: 22812

Notes: #22812e

Abstract: The main coffee soils in Kenya have been found to be low in nitrogen (Pereira and Jones, 1954). Past studies have confirmed positive coffee yield responses to nitrogen fertilizers (Oruko, 1977; Michori, 1981; Njoroge 1985a, 1985b; Njoroge and Mwakha 1985a, 1985b and 1986). A need exists to consider fertilization in relation to changes in plant population (Huxley, 1968). Information to guide application of optimal nitrogen fertilizer for high density coffee is lacking. The objective of this study was, therefore, to determine the influence of nitrogen fertilizer and plant density on growth and yield of arabica coffee.

Njoroge J. M., K. Waithaka, and J. A. Chweya. 1993. Effects of Intercropping Young Plants of the Compact Arabica Coffee Hybrid Cultivar Ruiru-11 with Potatoes, Tomatoes, Beans and Maize on Coffee Yields and Economic Returns in Kenya. *Experimental Agriculture*, 29:373-377.

Reference ID: 22813

Notes: #22813e

Abstract: The effects of intercropping young plants of the compact arabica coffee hybrid cultivar Ruiru 11 with potatoes, tomatoes, maize and *Phaseolus* (dry) beans were studied between 1987 and 1989 at Ruiru in Kenya. Yields of clean (hulled) coffee were reduced by the maize intercrop by 59-100%. Coffee bean size, and raw, roast and liquor quality were not significantly affected by the potato, tomato and bean intercrops, which gave positive net economic benefits. Potatoes planted between all the coffee rows gave the largest marginal rate of economic return, followed by tomatoes in combination with beans. The technically and economically viable intercrops for coffee were potatoes, tomatoes, beans, and tomatoes in combination with beans.

Mganga K. Z. and Y. Kuzyakov. 2014. Glucose decomposition and its incorporation into soil microbial biomass depending on land use in Mt. Kilimanjaro ecosystems. *European Journal of Soil Biology*, 62:74-82.

Reference ID: 22814

Notes: #22814e

Abstract: Land use change can affect terrestrial C stocks, resulting in increased CO₂ flux from soil to the atmosphere. In Africa, conversion of natural ecosystems to agricultural lands is the most common land use change. This study investigated the effects of six land use types occurring in Mt. Kilimanjaro ecosystems i.e. (1) lower montane forest (2) grassland and (3) savannah (natural ecosystems) (4) Chagga homegardens (semi-natural ecosystem) and (5) maize fields and (6) coffee plantation (agroecosystems) on microbial biomass carbon (MBC) and dynamics of C-14 labelled glucose added into soil. Decomposition of C-14 labelled glucose and its incorporation into microbial biomass in surface soils (0-10 and 10-20 cm) were determined. MBC decreased significantly with increased intensity of land use. Mineralization of the C-14 labelled glucose occurred in two phases with contrasting rates: 0-10 days (6-18% of C-14) and 15-65 days (<0.1% of C-14 d⁻¹). Land use intensification in agroecosystems led to an average increase of glucose decomposition of 14%. The decay rates of the labile C pool in intensively used agricultural lands were up to three times higher compared to natural ecosystems. The incorporation of C-14 glucose into microorganisms ranged between 1 and 7% of C-14 input in all soils, and was highest in savannah. Agricultural intensification decreased C content in soil through increased mineralization of organic substances and negatively impacted the upper soil layer more compared to the lower one. Based on these results we conclude that semi-

natural ecosystems (e.g. Chagga homegardens) are more sustainable in Mt. Kilimanjaro ecosystems compared to intensive agroecosystems.

Rice R. A. 2008. Agricultural intensification within agroforestry: The case of coffee and wood products. *Agriculture, Ecosystems & Environment*, 128:212-218.

Reference ID: 22815

Notes: #22815e

Abstract: Compared to the environmental and conservation value as refuges for biodiversity, less is known about the social and economic value of shaded coffee systems. The agroforestry system can serve as a source of non-coffee products for diverse purposes. This study focuses on the role of shade trees in smallholder coffee farms, examining the wood products derived from the shaded coffee system. Data presented from surveys with 185 growers in Peru and 153 growers in Guatemala show that the consumption and sale of all non-coffee products account for a fifth to a third of the total value realized from the agroforestry system. Fuelwood and construction materials account for much of this value. Differences seen between countries can be traced to agricultural intensification - the degree to which the coffee agroforestry system is "technified" (i.e., managed with a reduced shade tree cover and diversity, high-yielding cultivars, agrochemical inputs, etc.) - as well as the relative demand for wood resources and farmers' access to natural forest systems.

Reis T. H. P., A. E. F. Neto, P. T. G. Guimarães, N. Curi, A. F. Guerra, and J. J. Marques. 2011. Dynamics of Forms of Inorganic Phosphorus in Soil under Coffee Plants as a Function of Successive Annual Additions of the Nutrient. *Communications in Soil Science and Plant Analysis*, 42: 980-991.

Reference ID: 22816

Notes: #22816e

Abstract: Phosphorus (P) dynamics and availability in soils are influenced by P fertilization. This paper aimed to evaluate inorganic P fractions bonded to calcium (Ca), iron (Fe), and aluminum (Al), associating them with soil mineralogy. The experiment was carried out using an acidic kaolinitic-oxidic soil, located in an irrigated area cultivated with coffee plants (*Coffea arabica* L.), submitted to successive annual fertilizations with triple superphosphate doses of 0, 50, 100 200, and 400 kg ha⁻¹ phosphorus pentoxide (P₂O₅) in randomized blocks with three replications. Phosphorus fractions were determined in soil samples collected at two depths, 0-10 and 10-20 cm, according to the methodology used by Chang and Jackson (1957). The inorganic P fractions presented the following sequence: P-Al P-Fe P-Ca. The dynamics of forms of inorganic P showed that P-Al is controlling the P bioavailability as a result of an acidic pH and a very simple and thermodynamically stable clay mineralogy, typical of very weathered and old tropical soils.

Cantarella H., B. van Raij, and J. A. Quaggio. 1998. Soil and plant analyses for lime and fertilizer recommendations in Brazil. *Communications in Soil Science and Plant Analysis*, 29:1691-1706.

Reference ID: 22817

Notes: #22817e

Abstract: The fertilizer recommendation guidelines for over 160 crops for the State of Sao Paulo, Brazil were updated in 1996 based on recent results of research on soil and plant analysis, and crop responses. Recommendations are based mainly on soil analysis and expected yield. Limestone rates are calculated to raise soil base saturation as a percentage of the cation exchange capacity (CEC) of the soil at pH

7.0, to levels which vary with crop species (i.e., to 50% for rice, coffee, and cassava, 60% for sugar cane and soybeans, 70% for cotton and maize, and 80% for grapes and onions). In addition, exchangeable magnesium (Mg) contents must reach a minimum level. Exchangeable subsoil aluminum (Al) and calcium (Ca), and clay content are used to determine rates of gypsum as amendment of subsoil acidity. Fairly consistent data on soil phosphorus (P) and potassium (K) calibration are available for Brazilian soils. Potassium rates are recommended based on values of soil exchangeable K and, for P fertilization, ion exchange resin-extractable P is used. For the later the ranges of interpretation of soil analysis are different for horticultural, annual, perennial, and forestry crops. No soil test is used for nitrogen (N) advisory purposes. For many crops, especially grains, N rates depend on the class of expected response to this element, defined as a function of previous management history, crop rotation, texture etc. For some perennial crops N fertilizer rates take into account leaf N contents which were shown to correlate well with N response for citrus, mango, and coffee. Soil analysis for micronutrients, extracted with hot water [boron (B)] or DTPA-TEA [iron (Fe), copper (Cu), manganese (Mn), and zinc (Zn)] is also used as criterion for fertilizer recommendation although for most crops only B and/or Zn are required.

Reynolds-Vargas J. S., D. D. Richter, and E. Bornemisza. 1994. Environmental Impacts of Nitrification and Nitrate Adsorption in Fertilized Andisols in the Valle Central of Costa Rica. *Soil Science*, 157:289-299.

Reference ID: 22818

Notes: #22818e

Abstract: A major scientific challenge for modern agriculture is control of off-site effects on the water resource. In the Valle Central of Costa Rica, coffee plantations may leach fertilizer-derived NO₃⁻ to groundwaters, as a result of high fertilization rates (annually approximately 270 kg/ha as N), highly permeable and well structured Andisols, and high rates of annual runoff (>1000 mm). The objective of this study was to examine several aspects of the nitrification and NO₃⁻ adsorption that control NO₃⁻ leaching from these highly productive soils. Monthly collections from four Andisols indicated that soil NO₃⁻ varied seasonally, with NO₃⁻ accumulating to about 280 kg/ha in the upper meter of soil during the 5-month dry season. Soil NO₃⁻ was reduced during wet season months, even though fertilization was confined to the wet season. During these months, soil NO₃⁻ averaged about 140 kg/ha as N in the upper meter of soil, apparently reduced by wet season leaching, root uptake, and, possibly, denitrification. Field and laboratory incubations at different soil moisture and temperature regimes demonstrated how soil microflora mineralized N and nitrified NH₄⁺ at relatively high rates, even at low water potentials, e.g., <-1.5 MPa. During the dry season, field incubations suggested that nitrification rates were about 30 kg/ha per month as N in the upper 20 cm of soil. Relatively large contents of NO₃⁻ can be adsorbed by these allophanous Andisols, especially at low pH (up to about 5 cmol/kg at pH <3). Nitrate adsorption potentially retards leaching of NO₃⁻ to groundwater; however, the effectiveness of adsorption as a protection of groundwater quality is probably limited due to high inputs of fertilizer N and to liming management of coffee soils that maintains relatively high soil pH. Additional research into the coffee N cycle and fertilizer efficiency in coffee is needed to ensure high coffee productivity and to protect aquifer water quality in the Valle Central.

Souza C. A. S., J. O. Siqueira, E. de Oliveira, and J. G. de Carvalho. 1991. Development and Nutrient Levels of Coffee Seedlings Inoculated with Mycorrhizal Fungi - Effect of Organic-Matter and Simple Superphosphate: Crescimento E Nutricao de Mudas de Cafeeiro Micorrizadas-Efeito da Materia Organica e Superfosfato Simples. *Pesquisa Agropecuaria Brasileira*, 26:1989-2005.

Reference ID: 22819

Notes: #22819e (in portuguese)

Abstract: It was studied the effects of inoculation with the endomycorrhizal fungus *Gigaspora margarita* on nutrition and growth of coffee (*Coffea arabica* L.) seedlings grown in fumigated soil treated with 0, 1, 2, 3, 4 and 5 kg per m³ as simple superphosphate, with and without organic matter (cattle manure) in substratum. One experiment was conducted in a glasshouse and the other in a commercial nursery. Growth and the nutrient were measured levels 120 days after inoculation and transplanted. At glasshouse the inoculated seedlings had higher levels of P and Cu and lower levels of N and Mn when compared with noninoculated seedlings. For the commercial nursery, the benefits of inoculation were minimum. The organic matter addition increased the growth and nutrient levels of coffee seedlings at both experiments. The influence of the different dosages of simple superphosphate and their effects on the presence of organic matter and effectiveness of the fungus and colonization of the roots are also discussed.

Zhan L., X. Li, J. Lu, Z. Liao, T. Ren, and R. Cong. 2014. Potassium Fixation and Release Characteristics of Several Normal and K-Exhausted Soils in the Middle and Lower Reaches of the Yangtse River, China. *Communications in Soil Science and Plant Analysis*, 45:2921-2931.

Reference ID: 22820

Notes: #22820e

Abstract: Potassium (K) fixation and release in soil are important factors affecting K availability to plants and the utilization efficiency of K fertilizer. Three typical soils (red soil, yellow cinnamon soil, and alluvial soil) were collected from the middle and lower reaches of Yangtse River, China, to study the K-fixation and K-release characteristics of the normal and K-exhausted soil. Results showed that K fixation of added K in K-exhausted soils were significantly ($P < 0.05$) greater than that of the normal soils. There were significantly ($P < 0.05$) negative correlations among K-fixation capacity, concentration of soil-available K, and K⁺ saturation. Irrespective of soil K exhaustion, K fixation of added K was in the order of red soil > yellow cinnamon soil > alluvial soil, but the cumulative amount of K released from the three soils during successive extractions with 1.0 mol L⁻¹ nitric acid (HNO₃) was in the opposite order. The cumulative amounts of K released with 1.0 mol L⁻¹ ammonium acetate (NH₄OAc) and 1.0 mol L⁻¹ HNO₃ extraction increased with the increasing numbers of extractions. The K-releasing power of soil by successive extraction decreased gradually and finally became almost constant. The release of K was lower in K-exhausted soil than in normal soil. Overall, the information obtained in this study will be helpful in formulating more precise K fertilizer recommendations for certain soils.

Ye D., T. Li, X. Zhang, Z. Zheng, S. Liu, and J. Li. 2014. P uptake characteristics and P removal potentials of *Pilea sinofasciata* grown under soils amended with swine manure. *Ecological Engineering*, 73:553-559.

Reference ID: 22821

Notes: #22821e

Abstract: Phytoextraction for animal manure impacted soils has been an attractive method to extract excess P. A mining ecotype (ME) and a non-mining ecotype (NME) of *Pilea sinofasciata* were grown in soils amended with swine manure (0-50 gkg(-1) soil) to investigate P uptake characteristics and the potentials of their use for P removal. Amendments of swine manure increased the biomass and P accumulation of *P. sinofasciata*, and the ME demonstrated greater shoot P accumulation (36.12-184.84 mg pot(-1)) than the NME (27.42-160.73 mg pot(-1)). Shoot and root P contents of *P. sinofasciata* were positively correlated with soil available P. Shoot P extraction ratio of the ME reached 13.40% when seedlings were grown in the presence of 25 g kg(-1) soil, which increased by 31.73% compared with that of the NME. Both ecotypes of *P. sinofasciata* showed high P removed from the soil, maximum potential yield and P removal after the addition of swine manure. This study establishes that both ecotypes of *P. sinofasciata* show great abilities of P uptake and P removal from soils contaminated by swine manure, and thus *P. sinofasciata* is a worthy candidate for phytoextraction.

Girija Veni V., R. K. Rattan, S. P. Datta, and K. L. Sharma. 2014. Zinc Sorption Behavior in Soils with Divergent Characteristics. *Communications in Soil Science and Plant Analysis*, 45:2697-2711.

Reference ID: 22822

Notes: #22822e

Abstract: Adsorption studies are important to determine the retention and release of applied plant nutrients and the efficiency of fertilization. The present study was conducted to delineate the zinc (Zn) adsorption behavior of soils with varying characteristics. In this study, adsorption behavior of Zn was studied at varying Zn concentrations and temperatures in three different soils collected from the Research Farm of Indian Agricultural Research Institute (IARI), New Delhi (Inceptisols, Typic Haplustepts), soil (Inceptisols, Typic Ustocrept) from a farmer's field in Shamgarh, Karnal, Harayana, and the Hayathnagar Research Farm of Central Research Institute For Dryland Agriculture (CRIDA), Hyderabad, (Haplustalf). The results of this study revealed that the adsorption of Zn as well as differential buffering capacity (DBC) was greater in Typic Haplustepts of IARI and Typic Ustocrept of Karnal than Haplustalf of CRIDA, Hyderabad. However, the supply power as well as percentage saturation (% sat.) was greater in Haplustalf of CRIDA, Hyderabad, than Typic Haplustepts of IARI and Typic Ustocrept of Karnal. The results also revealed that irrespective of the soil types, Zn adsorption increased with an increase in Zn concentration and increase in temperature from 20 degrees C to 35 degrees C. When the adsorption data were fitted to isotherms, Langmuir and Freundlich isotherm fits were excellent, as evidenced by high r^2 (0.71 to 0.99) values. Thermodynamic parameters such as standard free energy (ΔG) were negative in both Typic Haplustepts and Typic Ustocrept soils, indicating spontaneous Zn adsorption reaction, but nonspontaneous reaction was observed in the case of Haplustalf soils. Interestingly, both standard enthalpy (ΔH) and standard entropy (ΔS) were negative in all the three types of soils studies. The analogy and results of the present study would be useful in deciding the Zn fertilizer needs for a given soil type.

Carvalho R. P., R. A. Moreira, M. C. M. Cruz, D. R. Fernandes, and A. F. Oliveira. 2014. Organomineral fertilization on the chemical characteristics of Quartzarenic Neosol cultivated with olive tree. *Scientia Horticulturae*, 176:120-126.

Reference ID: 22823

Notes: #22823e

Abstract: Research was carried out to evaluate the chemical characteristics of Quartzarenic Neosol cultivated with olive tree (*Olea europaea* L.) using organomineral fertilization and reduced amounts of chemical fertilization. Three-year-old olive trees of the variety 'Grappolo 541' were planted with a spacing of three meters between plants and five meters between rows in the area studied. The four treatments were 100%, 75%, 50% and 0% of the mineral fertilizer recommended for olive tree in a randomized block design with five replications and three plants per plot. The split-plot scheme was used, with four fertilization treatments in plot and sub-plot evaluation times. The organomineral fertilizer was applied to all plants in November 2011 and October 2012. Soil samples were taken before fertilization (November 2011) and after fertilization (July 2012 and June 2013). The data were subjected to an analysis of variance and regression with $p < 0.05$. The chemical characteristics of the soil improved with organomineral application and reduction of the chemical fertilizer to 50%. Organomineral fertilization is an excellent alternative for olive trees cultivated in Quartzarenic Neosol.

Hoffman S. and A. Leossa. 2013. Impact of mineral and organic fertilization on yield, C content in the soil, as well as on C, N and energy balances in a long-term field experiment. *Archives of Agronomy and Soil Science*, 59:1133-1142.

Reference ID: 22824

Notes: #22824e

Abstract: Data from a 49-year-long organic-mineral fertilization field experiment with a potato-maize-maize-wheat-wheat crop rotation were used to analyse the impact of different fertilizer variations on yield ability, soil organic carbon content (SOC), N and C balances, as well as on some characteristic energy balance parameters. Among the treatments, the fertilization variant with 87kg ha^{-1} year $^{-1}$ N proved to be economically optimal (94% of the maximum). Approximately 40 years after initiation of the experiment, supposed steady-state SOC content has been reached, with a value of 0.81% in the upper soil layer of the unfertilized control plot. Farmyard manure (FYM) treatments resulted in 10% higher SOC content compared with equivalent NPK fertilizer doses. The best C balances were obtained with exclusive mineral fertilization variants (-3.8 and -3.7 tha $^{-1}$ year $^{-1}$, respectively). N uptake in the unfertilized control plot suggested an airborne N input of 48kg ha^{-1} year $^{-1}$. The optimum fertilizer variant (70tha $^{-1}$ FYM-equivalent NPK) proved favourable with a view to energy. The energy gain by exclusive FYM treatments was lower than with sole NPK fertilization. Best energy intensity values were obtained with lower mineral fertilization and FYM variants. The order of energy conversion according to the different crops was maize, wheat and potato.

Fodor N., p. Csatho, T. Arendas, L. Radimsky, and T. Nemeth. 2013. Crop Nutrient Status and Nitrogen, Phosphorus, and Potassium Balances Obtained in Field Trials Evaluating Different Fertilizer Recommendation Systems on Various Soils and Crops in Hungary. *Communications in Soil Science and Plant Analysis*, 44:996-1010.

Reference ID: 22825

Notes: #22825e

Abstract: Based on correlations calculated from the database of long-term fertilization experiments carried out in Hungary between 1960 and 2000, a new, cost-saving, and environmentally friendly fertilizer recommendation system was developed. The aim of the new system is to apply the lowest possible nitrogen (N)-phosphorus (P)-potassium (K) rates required to achieve good yields and maximum income per unit area. The World Phosphorus Institute (IMPHOS) agreed to finance a 3-year program to test

various Hungarian fertilizer recommendation systems (the new RISSAC-RIA [Research for Soil Science and Agricultural Chemistry-Research Institute for Agriculture] system, the Talajergazdalkodás integrated soil fertility management system, and the intensive MEM NAK [Department of Plant Protection and Agricultural Chemistry of the Ministry of Food and Agriculture] system) when applied to three major crops grown on three characteristic Hungarian soils. The first five treatments in the experiment represented a classical deficiency experiment, aimed at checking the correctness of the NPK supply categories determined by the various systems. On all three soils and for all three crops the IMPHOS experiments confirmed the basic principles of the new cost-saving, environmentally friendly fertilizer recommendation system and the correctness of the methods used for calculating fertilizer rates. In this article, diagnostic plant analysis, soil analysis data, and NPK balances obtained in the different recommendations are discussed. In most cases the plant NPK contents of all the recommendations exceeded the lower limits of the good NPK supply category for wheat and barley shoot as well as for corn leaf. Crop NPK contents in Talajergazdalkodás and MEM NAK treatments (with greater recommended NPK doses) were most cases better than in the RISSAC-RIA treatments; however, the better crop NPK status did not result in extra grain yield in the former treatments. Taking into account that similarly high yields were obtained using the RISSAC-RIA system and the Talajergazdalkodás integrated system with much smaller NPK doses than those recommended by the intensive MEM NAK system, it was more advantageous from agronomic, environmental protection, and economic points of view. Differences in PK balances correlated well with the differences in the measured soil ammonium lactate (AL)-PK contents after the third year of the experiment.

Jung K.-Y., E.-S. Yun, C.-Y. Park, J.-B. Hwang, Y.-D. Choi, and I.-S. Oh. 2013. Changes of Soil Physical Properties by Manured Sorghum Residues Incorporation. Korean Journal of Soil Science and Fertilizer, 46:379-385.

Reference ID: 22826

Notes: #22826e (note: in Korean)

Abstract: Although sorghum residue production was estimated to be 8~10 Mg ha⁻¹, most sorghum straw was used to be burnt or removed after harvest. This experiment was conducted to evaluate the effect of the incorporation of manured sorghum residues on soil physical properties from 2010 to 2012 in the converted paddy field. Five treatment with 3 replication consisted of control, inorganic fertilizer (NPK), manured residues, sorghum stover and sawdust manure. The incorporation level of organic source was 10 Mg ha⁻¹ without inorganic fertilizer NPK. The investigated physical parameters were bulk density (BD), porosity, water stability aggregate (WSA), water infiltration rater (WIR), penetration resistance (PR) and soil water retention characteristics (WRC) with soil depth. The incorporation of manured sorghum residues improved WIR significantly over inorganic fertilizer (NPK), sorghum residues and sawdust manure. The BD by incorporating with manured residues on sorghum was reduced significantly with crop residue over plot of NPK and sawdust. Significant increase in WSA was observed with stubble incorporation alone or manured sorghum residues. Soil WRC were significantly enhanced with manured sorghum residue incorporated without NPK. The average PR at 0~15 cm was 0.54 MPa for manured sorghum residues. For sawdust manure plot it was 0.42MPa, for Sawdust manure plot 0.39 MPa and for NPK plot 0.54 MPa.

Corley R. H. V. and P. B. Tinker 2016. *The Oil Palm* (5th Ed.), Wiley Blackwell.

Reference ID: 22827

Notes: S 8.1.1 #22827

Abstract: The oil palm is the world's most valuable oil crop. Its production has increased over the decades, reaching 56 million tons in 2013, and it gives the highest yields per hectare of all oil crops. Remarkably, oil palm has remained profitable through periods of low prices. Demand for palm oil is also expanding, with the edible demand now complemented by added demand from biodiesel producers. *The Oil Palm* is the definitive reference work on this important crop. This fifth edition features new topics - including the conversion of palm oil to biodiesel, and discussions about the impacts of palm oil production on the environment and effects of climate change alongside comprehensively revised chapters, with updated references throughout.

The Oil Palm, Fifth Edition will be useful to researchers, plantation and mill managers who wish to understand the science underlying recommended practices. It is an indispensable reference for agriculture students and all those working in the oil palm industry worldwide.

van Hall C. J. J. 2016. *Cocoa* (1914), Kessinger Legacy Reprints.

Reference ID: 22828

Notes: S 8.1.4 #22828

Abstract: This scarce antiquarian book is a facsimile reprint of the original. Due to its age, it may contain imperfections such as marks, notations, marginalia and flawed pages. Because we believe this work is culturally important, we have made it available as part of our commitment for protecting, preserving, and promoting the world's literature in affordable, high quality, modern editions that are true to the original work.

Kannan P., P. Balasubramanian, P. Mahimairaj, and G. Prabukumar. 2015. Developing and Evaluation of Ecofriendly Fertilizer from Poultry Waste to Enhance Pulse Production in Alfisols of Semi-arid Tropics. *Communications in Soil Science and Plant Analysis*, 46:195-209.

Reference ID: 22829

Notes: #22829e

Abstract: Poultry manure (PM) has long been recognized the most desirable organic fertilizer. It improves soil fertility by adding both major and essential nutrients, as well as soil organic matter, which improves moisture and nutrient retention. The present study investigates the effectiveness of different levels of applied poultry-manure compost (PMC) and phospho-poultry-manure compost (PPMC) on the growth and yield of blackgram (*Vigna mungo* L). A field experiment was conducted to assess the nutrient-supplying capacity and soil health improvement potential of PMC and PPMC at 3.12, 6.25, 9.37, and 12.5 t/ha and to find the optimum dose of PMC as an organic fertilizer to maximize the pulse production in Alfisols of semi-arid tropics. Application of PPMC at 12.5 and 9.37 t ha⁻¹ increased the seed yield 105% and 102% more than the no-manure plot. Application of PMC at 12.5 t ha⁻¹ recorded 80% yield increment than no manure applied and the yield difference of PPMC was 20 to 25% greater than PMC alone. Application of PPMC at 12.5 and 9.37 t ha⁻¹ resulted in desirable soil physical and chemical properties especially 85 and 70% soil-available P improvement and significant role in increasing yield of blackgram. Application of PPMC at 9.37 t ha⁻¹ was found to be economically viable to the farmers in terms of improvement in soil properties and crop yield.

Moshia M. E., R. Khosla, J. G. Davis, D. G. Westfall, and K. Doesken. 2015. Precision Manure Management on Site-Specific Management Zones: Topsoil Quality and Environmental Impact. *Communications in Soil Science and Plant Analysis*, 46:235-258.

Reference ID: 22830

Notes: #22830e

Abstract: Maintenance and improvement of soil quality across spatially variable soils in continuous cropping systems are critical to sustaining agricultural productivity and environmental quality. The objectives of this project were (i) to study the effects of variable-rate application of animal manure on selected topsoil quality parameters across site-specific management zones (MZs) and (ii) to evaluate the variable-rate applications of manure using risk-assessment tools of nitrogen (N) leaching and phosphorus (P) runoff indices to understand its impact on environmental quality. This study was conducted in northeastern Colorado on continuous and furrow-irrigated maize fields. Experimental strips, 4.5 m wide and 540 m long, spanned across all MZs with treatments nested within MZs in the field. Variable rates of dairy and beef feedlot manure applied on irrigated and dryland fields respectively ranged from 0 to 67 Mg ha⁻¹. Surface soil quality parameters evaluated before and after this study included bulk density, organic matter, water-holding capacity, electrical conductivity, and particle-size analysis. Results indicate that animal manure applications of 44 and 67 Mg ha⁻¹ significantly ($P \leq 0.05$) increased soil organic matter and decreased bulk density of low- and medium-productivity-level MZs and had no significant impact on surface soil organic matter and bulk density of the high-productivity-level MZs. Animal manure significantly ($P \leq 0.05$) increased surface soil water-holding capacity and soil electrical conductivity across zones; however, the maximum manure-induced soil EC was 1.0 dS m⁻¹, which was below levels regarded as potentially harmful for maize production. Soil texture was not affected by animal manure applications. Colorado N leaching and P index indicated no environmental hazard associated with variable rate application of animal manure across MZs. This study indicates that variable-rate application of animal manure across MZs has potential to improve or maintain soil quality parameters over time without impairing the environment.

Parvathy P. C., A. N. Jyothi, K. S. John, and J. Sreekumar. 2014. Cassava Starch Based Superabsorbent Polymer as Soil Conditioner: Impact on Soil Physico-Chemical and Biological Properties and Plant Growth. *Clean Soil Air Water*, 42:1610-1617.

Reference ID: 22831

Notes: #22831e

Abstract: Superabsorbent polymers (SAPs) are macromolecules with the ability to absorb water and release it slowly to the surroundings. SAP hydrogels can be used as soil moisture conditioners which act as water reservoirs and release water depending upon the need of plant roots. In the present study, a cassava starch based superabsorbent hydrogel was evaluated as a soil conditioner and its effect on physical, chemical, and biological properties of the soil as well as on plant growth parameters was studied. Amendment of the soil with the starch based SAP hydrogel significantly altered the physical and chemical properties of the soil. Bulk density of the soil was decreased, whereas water holding capacity and porosity were increased on SAP treatment. There was an improvement in the soil status of major, secondary and micronutrients and organic carbon in the SAP amended soil. An increase in bacteria (16%) and fungi counts (18%) as well as superior plant growth were observed for the treatment with SAP and irrigated at an interval of 3 days, compared to those of control without SAP. Soil amendment with starch based SAP hydrogel was found to be

beneficial for maintaining the physicochemical and biological soil properties as well as plant growth.

Curaqueo G., M. Schoebitz, F. Borie, F. Caravaca, and A. Roldan. 2014. Inoculation with arbuscular mycorrhizal fungi and addition of composted olive-mill waste enhance plant establishment and soil properties in the regeneration of a heavy metal-polluted environment. *Environmental Science And Pollution Research*, 21:7403-7412.

Reference ID: 22832

Notes: #22832e

Abstract: A greenhouse experiment was carried out in order to investigate the effects of arbuscular mycorrhizal (AM) fungi inoculation and the use of composted olive waste (COW) in the establishment of *Tetraclinis articulata* and soil properties in a heavy metal-polluted soil. The treatments assayed were as follows: AM + 0 % COW, AM + 1 % COW, and AM + 3 % COW. The higher doses of COW in combination with AM fungi increased shoot and root biomass production of *T. articulata* by 96 and 60 %, respectively. These treatments trended to improve the soil properties evaluated, highlighting the C compounds and N as well as the microbiological activities. In relation to the metal translocation in *T. articulata*, doses of COW applied decreased the Cr, Ni, and Pb contents in shoot, as well as Cr and As in root, although the most of them reached low levels and far from phytotoxic. The COW amendment aided *Glomus mosseae*-inoculated *T. articulata* plants to thrive in contaminated soil, mainly through an improvement in both nutrients uptake, mainly P and soil microbial function. In addition, the combined use of AM fungi plus COW could be a feasible strategy to be incorporated in phytoremediation programs because it promotes soil properties, a better performance of plants for supporting the stress in heavy metal-contaminated soils derived from the mining process, and also can be a good way for olive-mill waste disposal.

Datta P. and M. Kulkarni. 2014. Influence of Two "Am" Fungi in Improvement of Mineral Profile in *Arachis Hypogaea* L. Under Salinity Stress. *Legume Reseach*, 37:321-328.

Reference ID: 22833

Notes: #22833e

Abstract: Increasing salinization of fertile soil is becoming a serious agricultural problem. Arbuscular mycorrhizal (AM) fungi improve plant growth by improving nutrient mobilization under salt stress. A greenhouse experiment was undertaken to check effect of *Glomus mosseae*, *Glomus fasciculatum* on mineral uptake of *Arachis hypogaea* under various salinity stresses. The experiment comprised of five salinity levels (EC: 1.04 (control), 2.10, 3.78, 5.94, 8.26 dS/m) and four mycorrhizal status as non-mycorrhizal (uninoculated), *G. mosseae* and *G. fascicula* turn individually and their mixed inoculation. Under salinity stress, mycorrhiza inoculated plants showed significant increase in Cu, Zn, K/Na, Mg/Na and Ca/Na ratios but, highest accumulation (P: 53.33%, Cu: 34.36%, Zn: 21.52%, Ca/Na: 50.43%, K/Na: 42.06% and Mg/Na: 57.26%) was observed in plants inoculated with mixed mycorrhizal fungi. Hence, in amelioration of salinity stress and to prevent nutrient imbalance in *A. hypogaea* plant, *G. mosseae* and *G. fasciculatum* in mixed treatment can be used.

Surekha K. and Y. S. Satishkumar. 2014. Productivity, Nutrient Balance, Soil Quality, and Sustainability of Rice (*Oryza sativa* L.) under Organic and Conventional Production Systems. *Communications in Soil Science and Plant Analysis*, 45:415-428.

Reference ID: 22834

Notes: #22834e

Abstract: A field experiment was conducted for 5 years (2004-2005 to 2009-2010) covering 10 crop seasons [five wet (WS; Kharif) and five dry (DS; Rabi)] at the Directorate of Rice Research farm, Hyderabad, India, to compare the influence of organic and conventional farming systems on productivity of fine grain rice varieties, cumulative partial nutrient balance, and soil health/quality in terms of nutrient availability, physical and biological properties, and sustainability index. Two main plot treatments were with and without plant protection measures, and four subplot treatments were (1) control (CON), (2) inorganic fertilizers (CF), (3) organics (OF), and (4) inorganics + organics (integrated nutrient management, INM). During wet season, grain yields with CF and INM were near stable (5.0 to 5.5 t ha⁻¹) and superior to organics by 15-20% during the first 2 years, which improved with OF (4.8 to 5.4 t ha⁻¹) in the later years to comparable levels with CF and INM. However, during DS, CF and INM were superior to OF for 4 consecutive years and OF recorded yields on par with CF and INM in the fifth year. The partial nutrient balance over 10 crop seasons for N and P was positive and greater with OF and INM over CF and for K it was positive with OF alone and negative with CF and INM. There were increases in SOC and available N, P, and K by 50-58%, 3-10%, 10-30%, and 8-25% respectively, with OF, over CF at the end of 5 years. The sustainability index (SI) of the soil system was maximum with organics (1.63) and CF recorded 1.33, which was just above the minimum sustainability index of 1.30 after 5 years. Thus, organic farming needs more than 2 years to stabilize rice productivity and bring about perceptible improvement in soil quality and sustainability in irrigated rice.

Pampolino M. 2016. Optimizing fertilizer formulation for smallholders in Asia and Africa. *Fertilizer Focus*, July/August 2016:42-45.

Reference ID: 22835

Notes: #22835e

Abstract: The demand for increased cereal production to feed an increasing world population would be better met by intensifying production of wheat, rice and maize to increase attainable yields, rather than by expanding cultivated areas.

MPS and IPS. 2016. Peatlands in Harmony - Agriculture, Industry and Nature - Oral Presentations. Pages 1-786.

Reference ID: 22836

Notes: #22836e

MPS and IPS. 2016. Peatlands in Harmony - Agriculture, Industry and Nature - Poster Presentations. Pages 1-612.

Reference ID: 22837

Notes: #22837e

IPNI. Better Crops with Plant Food Vol.100 (2016, No. 3). Better Crops With Plant Food 100[3], 1-24. 2016.

Reference ID: 22838

Notes: #22838e

Byerlee D. and X. Rueda. 2015. From Public to Private Standards for Tropical Commodities: A Century to Global Discourse on Land Governance on the Forest Frontier. *Forests*, 6:1301-1324.

Reference ID: 22839

Notes: #22839e

Abstract: Globalization and commodity exports have a long history in affecting land use changes and land rights on the tropical forest frontier. This paper reviews a century of social and environmental discourse around land issues for four commodities grown in the humid tropics—rubber, cocoa, oil palm and bananas. States have exercised sovereign rights over land and forest resources and the outcomes for deforestation and land rights of existing users have been quite varied depending on local institutional contexts and political economy. In the current period of globalization, as land use changes associated with tropical commodities have accelerated, land issues are now at center stage in the global discourse. However, efforts to protect forests and the rights of local communities and indigenous groups continue to be ad hoc and codification of minimum standards and their implementation remains a work in progress. Given a widespread failure of state directed policies and institutions to curb deforestation and protect land rights, the private sector, with the exception of the rubber industry, is emphasizing voluntary standards to certify sustainability of their products. This is an important step but expectations that they will effectively address concerns about the impact of tropical commodities expansion might be too high, given their voluntary nature, demand constraints, and the challenge of including smallholders. It is also doubtful that private standards can more than partially compensate for long standing weaknesses in land governance and institutions on the forest frontier.

Guillaume T., M. Damris, and Y. Kuzyakov. 2016. Losses of soil carbon by converting tropical forest to plantations: erosion and decomposition estimated by C. *Global Change Biology*, 2015:1-13.

Reference ID: 22840

Notes: #22840e

Abstract: Indonesia lost more tropical forest than all of Brazil in 2012, mainly driven by the rubber, oil palm, and timber industries. Nonetheless, the effects of converting forest to oil palm and rubber plantations on soil organic carbon (SOC) stocks remain unclear. We analyzed SOC losses after lowland rainforest conversion to oil palm, intensive rubber, and extensive rubber plantations in Jambi Province on Sumatra Island. The focus was on two processes: (1) erosion and (2) decomposition of soil organic matter. Carbon contents in the Ah horizon under oil palm and rubber plantations were strongly reduced up to 70% and 62%, respectively. The decrease was lower under extensive rubber plantations (41%). On average, converting forest to plantations led to a loss of 10 Mg C ha⁻¹ after about 15 years of conversion. The C content in the subsoil was similar under the forest and the plantations. We therefore assumed that a shift to higher δ(13) C values in plantation subsoil corresponds to the losses from the upper soil layer by erosion. Erosion was estimated by comparing the δ(13) C profiles in the soils under forest and under plantations. The estimated erosion was the strongest in oil palm (35 ± 8 cm) and rubber (33 ± 10 cm) plantations. The (13) C enrichment of SOC used as a proxy of its turnover indicates a decrease of SOC decomposition rate in the Ah horizon under oil palm plantations after forest conversion. Nonetheless, based on the lack of C input from litter, we expect further losses of SOC in oil palm plantations, which are a less sustainable land use compared to rubber plantations. We conclude that δ(13) C depth profiles may be a powerful tool to

disentangle soil erosion and SOC mineralization after the conversion of natural ecosystems conversion to intensive plantations when soils show gradual increase of d(13) C values with depth.

Meisner M. H., J. A. Rosenheim, and I. Tagkopoulos. 2016. A data-driven, machine learning framework for optimal pest management in cotton. *Ecosphere*, 7:1-13.

Reference ID: 22841

Notes: #22841e

Abstract: Despite the significant effects of agricultural pest management on crop yield, profit, environmental quality, and sustainability, farmers oftentimes lack data-driven decision support to help optimize pest management strategies. To address this need, we curated a comprehensive data set that consists of pest, pest management, and yield information from 1498 commercial cotton crops in California's San Joaquin Valley between 1997 and 2008. Using this data set, we built a Markov decision process model to identify the optimal management policy of a key cotton pest, *Lygus hesperus*, that balances the tradeoff between yield loss and the cost of pesticide applications. Our results show that pesticide applications targeting *L. hesperus* are only economically optimal during the first 2 weeks of June, and pesticide applications were associated with increased risk of an unprofitable harvest. About 46% of the observations in our data set involved at least one pesticide application outside of this optimal window, demonstrating the need for a data-driven approach to crop management. Sensitivity analyses on parameter perturbations and reduced data set sizes suggest that our methodology provides a robust policy-making tool, even in noisy data sets.

Schwarze S., M. Euler, M. Gatto, J. Hein, E. Hettig, A. M. Holtkamp, L. Izhar, Y. Kunz, J. Lay, J. Merten, S. Moser, O. MuBhoff, F. Otten, M. Qaim, E. Soetarto, S. Steinebach, K. Trapp, M. Vorlaufer, and H. Faust. 2015. Rubber vs. oil palm: an analysis of factors influencing smallholders' crop choice in Jambi, Indonesia. *Efforts discussion paper series*, 11:1-35.

Reference ID: 22842

Notes: #22842e

Abstract: The rapid expansion of the oil palm area in many tropical countries has raised concerns about its negative impact on local communities, food security, and on the environment. While the expansion of oil palm in early stages was mainly driven by large private and public companies, it is expected that smallholders will outnumber large estates in the near future. For policy formulation it is hence important to better understand who these smallholders are and why they have started to cultivate oil palm. In this paper, we used a rich dataset collected in the province of Jambi, which is one of the most important production areas for oil palm, to analyse smallholders' decision making by combining qualitative, quantitative, and experimental methods. We identified agricultural expertise, lacking flexibility in labour requirements, availability of seedlings, and investment costs as the major constraints for farmers to cultivate oil palm. Important reasons for oil palm cultivation are the higher returns to labour and the shorter immature phase of oil palm. We also showed that oil palm farmers are neither risk-averse nor risk-loving, rather, they appear to be risk-neutral.

IRDR, IRG, and ASTAAG. ASIA Science Technology Status For Disaster Risk Reduction 2016. 1-106. 2016.

Reference ID: 22843

Notes: #22843e

Abstract: Disasters are increasing, and Asia bears the maximum impacts of the disasters, in terms of number of people affected, as well as human and economic losses. Science and Technology for disaster risk reduction has always been there in some form in different countries. Through the advancement of scientific research, disaster risk reduction has been benefitted, especially in terms of early warning system, to identify risk in both spatial and temporal scale, strengthening of buildings and infrastructures for different types of hazards etc. There have also been significant achievements in recognizing higher education in disaster studies into other higher education curriculum. In recent years, apart from hard science, which is more on innovations and engineering, soft science or social sciences have also got prominence and importance. Through different major disasters, it has been realized that there needs to be a good balance between hard and soft technology, and engineering solutions and social solutions.

Wu F. Y., J. Wan, S. Wu, X. Lin, and M. Wong. 2013. Inoculation of Earthworms and Plant Growth-Promoting Rhizobacteria (PGPR) for the Improvement of Vegetable Growth via Enhanced N and P Availability in Soils. *Communications in Soil Science and Plant Analysis*, 44:2974-2986.

Reference ID: 22844

Notes: #22844e

Abstract: A pot trial was conducted to investigate the single, dual, and triple inoculation of earthworms or plant growth-promoting rhizobacteria (PGPR), including nitrogen-fixing bacteria (NFB) (*Azotobacter chroococcum* HKN-5) and phosphate-solubilizing bacteria (PSB) (*Bacillus megaterium* HKP-1), on the growth of *Brassica parachinensis* and nitrogen (N) and phosphorus (P) availability in soils. All of the five inoculation treatments significantly ($P < 0.05$) increased the shoot growth of *B. parachinensis*. The greatest shoot and root biomass were recorded in the triple inoculation of earthworm, NFB, and PSB. All of the five inoculation treatments significantly ($P < 0.05$) increased the concentrations of ammonium (NH_4^+)-N, NO_3^- -N, and sodium bicarbonate (NaHCO_3)-extractable P in soils. Based on plant growth and availability of N and P in soils, the present study suggested that the triple inoculation may be a promising approach for reducing the need for chemical fertilizers in growing vegetables.

Vaneekhaute C., E. Meers, E. Michels, G. Ghekiere, F. Accoe, and F. M. G. Tack. 2013. Closing the nutrient cycle by using bio-digestion waste derivatives as synthetic fertilizer substitutes: A field experiment. *Biomass & Bioenergy*, 55:175-189.

Reference ID: 22845

Notes: #22845e

Abstract: In the transition from a fossil to a bio-based economy, it has become an important challenge to maximally recycle valuable nutrients that currently end up in waste streams. Nutrient resources are rapidly depleting. Significant amounts of fossil energy are required for the production of synthetic fertilizers, whereas costs for energy and fertilizers are increasing. Meanwhile, biogas production through anaerobic digestion produces nutrient-rich digestates, which could potentially be reused as green fertilizers in agriculture, thereby providing a sustainable substitute for synthetic fertilizers. The aim of this study was to evaluate the impact of using bio-digestion waste derivatives instead of synthetic fertilizers and/or animal manure on soil and crop production. In a field trial, nutrient balances were assessed and the physicochemical soil fertility and quality were evaluated. The biogas yield of the harvested energy crops was determined. An economic and ecological evaluation was conducted. Application

of bio-digestion waste derivatives induced small, albeit statistically insignificant improvement in crop yield, soil fertility and quality compared to current common practices using animal manure and synthetic fertilizers. Moreover, the use of these products might stimulate nutrient mobilization from the soil, thereby increasing the use efficiency of soil minerals. For all reuse scenarios the calculated economic and ecological benefits were significantly higher than the reference. It is clear that the reuse of bio-based products as nutrient supply in agriculture should be stimulated in European legislation. Further field research is on-going in order to validate the results and evaluate the impact on soil quality in the longer term.

Agbede T. M., A. O. Adekiya, and J. S. Ogeh. 2013. Effects of organic fertilizers on yam productivity and some soil properties of a nutrient-depleted tropical Alfisol. *Archives of Agronomy and Soil Science*, 59:803-822.

Reference ID: 22846

Notes: #22846e

Abstract: Field experiments were conducted at Owo, southwest Nigeria to select organic fertilizer treatments most suitable for sustaining high soil fertility and yam productivity on a nutrient-depleted tropical Alfisol. Eight organic fertilizer treatments were applied at 20 t ha⁻¹ with a reference treatment inorganic fertilizer (NPK 15-15-15) at 400 kg ha⁻¹ and natural soil fertility (control), laid out in a randomized complete block design with three replications. Results showed that organic fertilizers significantly increased ($p=0.05$) tuber weight and growth of yam, soil and leaf N, P, K, Ca and Mg, soil pH and organic C concentrations compared with the NSF (control). The oil palm bunch ash+poultry manure treatment increased tuber weight, vine length, number of leaves and leaf area of yam by 66, 25, 21 and 52%, respectively, compared with inorganic fertilizer (NPK) and 37, 22, 19 and 44%, respectively, compared with poultry manure alone. Sole or mixed forms of organic fertilizers showed significant improvement in soil physical conditions compared with IF (NPK) and NSF (control). Synergistic use of oil palm bunch ash+poultry manure at 10 t ha⁻¹ each was most effective for sustainable management of soils and for improving agronomic productivity of yam.

Arakawa Y. and K. Yamamoto. 2012. Improvement of soil fertility by fallow flooding for groundwater conservation on the middle reaches of the Shirakawa River in Kumamoto, Japan. *Archives of Agronomy and Soil Science*, 58:213-218.

Reference ID: 22847

Notes: #22847e

Abstract: Fallow flooding at converted paddy fields on the middle stream of the Shirakawa river basin, Kumamoto Japan is encouraged by the local government since the practice is effective for artificial groundwater recharge. In this study, we investigated the effects of fallow flooding on the water quality of percolating water, soil fertility, and succeeding carrot (*Daucus carota* L.) production. The flooding was conducted at a converted paddy field in 2007. Nitrate concentration of percolating water surged immediately after the start of flooding, due to the leaching of residual nitrate in the soil layer; then dropped to less than the concentration of irrigation water, supposedly due to denitrification thereafter. Denitrification rate was calculated as 0.22 g-NO₃⁻-N m⁻²d⁻¹; such a rate may alleviate the nitrate contamination caused at the very beginning of flooding. Regardless of severe leaching conditions, soil nutrient contents were maintained or rather increased in the drained soil. Carrot yield 158 days after sowing in the test field was 67 Mg ha⁻¹, far exceeding the yield of 41 Mg ha⁻¹ in the untreated adjacent field. Flood fallowing, known as an efficient practice for

suppressing pathogenic nematodes and/or continuous cropping injury, appears to be a favorable practice for improvement of soil fertility.

Roudier P., B. Sultan, P. Quirion, and A. Berg. 2011. The impact of future climate change on West African crop yields: What does the recent literature say? *Global Environmental Change*, 21:1073-1083.

Reference ID: 22848

Notes: #22848e

Abstract: In West Africa, agriculture, mainly rainfed, is a major economic sector and the one most vulnerable to climate change. A meta-database of future crop yields, built up from 16 recent studies, is used to provide an overall assessment of the potential impact of climate change on yields, and to analyze sources of uncertainty. Despite a large dispersion of yield changes ranging from -50% to +90%, the median is a yield loss near -11%. This negative impact is assessed by both empirical and process-based crop models whereas the Ricardian approach gives very contrasted results, even within a single study. The predicted impact is larger in northern West Africa (Sudano-Sahelian countries, -18% median response) than in southern West Africa (Guinean countries, -13%) which is likely due to drier and warmer projections in the northern part of West Africa. Moreover, negative impacts on crop productivity increase in severity as warming intensifies, with a median yield loss near -15% with most intense warming, highlighting the importance of global warming mitigation. The consistently negative impact of climate change results mainly from the temperature whose increase projected by climate models is much larger relative to precipitation change. However, rainfall changes, still uncertain in climate projections, have the potential to exacerbate or mitigate this impact depending on whether rainfall decreases or increases. Finally, results highlight the pivotal role that the carbon fertilization effect may have on the sign and amplitude of change in crop yields. This effect is particularly strong for a high carbon dioxide concentration scenario and for C3 crops (e.g. soybean, cassava). As staple crops are mainly C4 (e.g. maize, millet, sorghum) in WA, this positive effect is less significant for the region.

Kombo G. R., A. Dansi, L. Y. Loko, G. C. Orkwor, R. Vodouhe, P. Assogba, and J. M. Magema. 2012. Diversity of cassava (*Manihot esculenta* Crantz) cultivars and its management in the department of Bouenza in the Republic of Congo. *Genetic Resources and Crop Evolution*, 59:1789-1803.

Reference ID: 22849

Notes: #22849e

Abstract: Cassava (*Manihot esculenta* Crantz) is one of the most produced and consumed food crops in the Republic of Congo. To assess the diversity and understand the traditional management of its cultivars in the department of Bouenza, twenty-one villages randomly selected from nine ethnic zones were surveyed using participatory rural appraisal. Altogether, 86 land races cultivars were recorded and further grouped into 36 types based on their agronomic and culinary characteristics. The number of cultivars accessed varied from 6 to 21 per village (13 on average) and from 1 to 11 (4 on average) per household. Their distribution and extent analysis revealed some worrying rates of cultivar loss in the range of 7.41-66.67% (32.06% on average) per village. The reasons of cultivars abandonment, the folk nomenclature and the traditional cutting supply system and planting techniques were documented and their importance in terms of genetic resources conservation and utilisation are discussed. Twenty farmers' cultivar preference criteria were identified and prioritised. Their relative importances were examined across ethnic groups. Among them, the

most important were yield, taste, cossette quality and root size which account for 72.39% of the total responses. The study revealed that most of the farmers did not consider the importance of the sexual reproduction in the cultivar diversification and the impact of cassava mosaic disease on the productivity of the infested plants. Awareness efforts and extension of the study to other cassava production zones were recommended for food security needs in Congo. To clarify synonym, morphological classification and molecular analysis were also suggested.

Raheem D. 2012. The need for agro-allied industries to promote food security by value addition to indigenous African food crops. *Outlook on Agriculture*, 40:343-349.

Reference ID: 22850

Notes: #22850e

Abstract: Food security is a major concern in developing countries and requires urgent attention and collaborative effort from all stakeholders. As the human population continues to increase, the demand for food becomes far greater than the supply can meet. There is a need to cultivate more indigenous food crops and to diversify into new products by using processing and preservation techniques to ensure that more people have access to good quality, nutritious foods. It is therefore essential that agro-allied industries in African countries receive encouragement to improve the application of technology for processing raw food crops, increasing their shelf life, improving nutritional values and packaging, and maintaining high quality standards. This paper emphasizes the potential benefits for three staple African foods maize, cassava and sorghum. The application of science to transform the properties of these foods and relevant technologies, such as extrusion cooking, can add value to their use in the immediate future and will help in meeting the Millennium Development Goals.

Rhodes E. R. 2003. Trends in food crop production in Sierra Leone and options for meeting food energy requirements. *Journal of Sustainable Agriculture*, 22:125-142.

Reference ID: 22851

Notes: #22851e

Abstract: Changes in the production of major food crops, available calories and protein for human consumption in Sierra Leone over a ten year period were studied. Estimates were made of nutrients taken up by harvested produce and present in crop residues. Plant sources provided 1,840 kcal/caput/day to 2,041 kcal/caput/day accounting for about 96% of total available calories. Rice, maize, millet, sorghum, cassava, sweet potato and groundnut provided a total of 1,084 kcal/caput/day to 1,305 kcal/caput/day. The difference between available calories and the minimum requirement in 1996 was 363 kcal/caput/day. Between 1987 and 1996 available calories from rice declined from 978 kcal/caput/day to 876 kcal/caput/day, while that from cassava increased from 90 kcal/caput/day to 205 kcal/caput/day. Rice was the most important supplier of proteins; it provided 16.4 g/caput/day to 18.9 g/caput/day. The data indicated that large amounts of nitrogen, phosphorus and potassium were removed by the crops from cultivated soils. Use of high yielding cassava and rice varieties with little or no fertilizers is a low input option that would bridge about 94% of the minimum energy gap. To minimize nutrient mining and completely fill the gap, these varieties would have to be used in conjunction with good soil management practices.

Wakugami K., H. Suenaga, A. Egashira, T. Taira, T. Tokashiki, T. Yamazaki, A. Maehara, and K. Uechi. 2000. Copper supplement with cocoa for copper deficiency in patients with long-term enteral nutrition. *Japanese Journal of Geriatrics (Nihon Ronen Igakkaizasshi)*, 37:304-308.

Reference ID: 22852

Notes: #22852e

Abstract: Copper deficiency (normal serum copper level: 78-136 micrograms/dl) has been reported in patients with long-term enteral nutrition, caused by a copper deficit in enteral nutrition. Occasionally, this leads to anemia and leukopenia. We used Hershey's pure cocoa that is rich in copper (content 3.8 mg/cocoa 100 g) for copper deficiency. A total of 86 (40 men and 46 women, mean age 69 years) patients on enteral nutrition were studied. The primary diseases were cerebral vascular disease in 71 patients, neurological disease in 5 and others in 10. Those who showed serum copper levels of 20 micrograms/dl or less (N = 8) were given 30-45 g of cocoa (copper content 1.14-1.71 mg) per day for about 40 days. Among them, two patients could not continue because of vomiting and diarrhea and were excluded from this study. Mean serum copper levels increased from 8.7 +/- 6.2 to 99.0 +/- 25.4 micrograms/dl (N = 6). Those who showed serum copper levels 20-77 mg/dl (N = 31) were given 10 g of cocoa (copper content 0.38 mg) per day for about 40 days. When mean serum copper levels increased from 50.5 +/- 19.3 to 89.0 +/- 12.9 micrograms/dl with cocoa administration, anemia and neutropenia caused by copper deficiency showed a tendency to improve. After completing the study period, cocoa was reduced to 5 g (copper content 0.19 mg) per day in 23 patients. The mean serum copper levels increased from 90.7 +/- 10.4 to 100.6 +/- 17.1 micrograms/dl for about 100 days. Recently, the amount of daily copper requirement for adults has been reported to be 1.28-2.5 mg per day. We showed that 10 g of cocoa (0.6 mg total copper: 0.38 mg in cocoa and 0.22 mg in other nutrients) is sufficient to treat copper deficiency, and 5 g of cocoa (0.37 mg total copper: 0.19 mg in cocoa and 0.18 mg in other nutrients) is enough to maintain the normal level of serum copper in patients with long-term enteral nutrition.

Ahmad W., F. Khan, and M. Naeem. 2014. Improvement in physical properties of eroded agricultural soils through agronomic management practices. *Indian Journal of Agricultural Sciences*, 84:850-855.

Reference ID: 22853

Notes: #22853e

Abstract: Arable land in Pakistan is shrinking due to construction of houses and development of infrastructure, there has been a trend of shifting agriculture towards steep lands in order to feed the increasing population. Soil erosion on these lands is one of the most significant ecological restrictions to sustainable agriculture. A study was conducted during 2006-2008 to test the agronomic management practices for mitigating the adverse effects of soil erosion on arable soil. The experiment was designed in RCB with split plot arrangements. Cropping patterns, i.e. maize (*Zea mays* L.)-wheat (*Triticum aestivum* L.)-maize (C1), maize-lentil (*Lens culinaris* Medic.)-maize (C2) and maize-wheat+lentil intercrop-maize (C3) were kept in main plots while fertilizer treatments; the control (T1), 50% NP also called farmers' practice (T2), 100% NPK or the recommended dose (T3) and 20 tonnes/ha farmyard manure integrated with 50% mineral N and 100% P and K (T4) were kept in sub-plots. Fertilizer treatments significantly improved soil physical properties in both depths. T4 showed the maximum improvement (13, 12, 22 and 31%) in bulk density, porosity, saturation and available water over the control and 3, 3, 8 and 7% over the T3 in surface soil. Cereal-legume rotation showed the maximum improvement while significant improvement in soil physical properties was noted with time, i.e. from kharif 2006 to rabi 2007. Highly significant negative correlation was observed between bulk density and saturation percentage ($r^2=0.97$) and bulk density and AWHC ($r^2=0.93$). It was

concluded that NPK fertilizer alone cannot restore the physical environment of eroded soil to its maximum limit, but this objective could, rather, be achieved through mixed application of farmyard manure and mineral fertilizers. For this purpose, being an unstable nutrient element, recommended dose of mineral N must be reduced by 50% to avoid its over-application. In addition to other benefits of legumes in rotation, its improvement of physical properties further assert their importance in farming on such eroded lands.

Suri V. K. and A. K. Choudhary. 2013. Effect of Vesicular Arbuscular-Mycorrhizal Fungi and Phosphorus Application through Soil-Test Crop Response Precision Model on Crop Productivity, Nutrient Dynamics, and Soil Fertility in Soybean-Wheat-Soybean Crop Sequence in an Acidic Alfisol. *Communications in Soil Science and Plant Analysis*, 44:2032-2041.

Reference ID: 22854

Notes: #22854e

Abstract: A field experiment was conducted in a phosphorus (P)-deficient acidic alfisol of the northwestern Himalayas using three vesicular arbuscular mycorrhizal (VAM) cultures: a local culture developed by CSK Himachal Pradesh Agricultural University, Palampur (*Glomus mosseae*), VAM culture from Indian Agricultural Research Institute (IARI), New Delhi (*Glomus mosseae*), and a culture from the Centre for Mycorrhizal Research, The Energy Research Institute (TERI), New Delhi (*Glomus intraradices*). These were applied alone or in combination with 25 to 75% of recommended P₂O₅ and recommended nitrogen (N) and potassium (K) based on soil-test crop response (STCR) precision model with an absolute control, farmers' practice, and 100% of recommended P₂O₅ dose based on the STCR model. The results revealed that sole application of either of the three VAM cultures have produced 2.68 to 9.81% and 25.06 to 28.62% greater grain yield than the control in soybean and wheat crops, respectively. Besides greater straw yield, NPK uptake as well as soil nutrient buildup increased. Increase in P fertilization from 25 to 75% of recommended P₂O₅ dose coupled with VAM inoculation with either of the three VAM cultures resulted in consistent and significant improvement in crop productivity (grain and straw yields), NPK uptake, and improved soil nutrient status, though significantly greatest magnitude was obtained with sole application of 100% of the recommended P₂O₅ dose. The targeted grain yields of soybean (25 q ha⁻¹) and wheat (30 q ha⁻¹) were achievable with 75% of recommended P₂O₅ dose along with mycorrhizal biofertilizers, thereby indicating that application of efficient VAM fungi with 75% of recommended P₂O₅ dose can economize the STCR precision model fertilizer P dose by about 25% without impairing crop yield targets or soil fertility in a soybean-based cropping system in an acidic alfisol.

Becx G. A., G. Mol, J. W. Eenhoorn, J. van der Kamp, and J. van Vliet. 2012. Perceptions on reducing constraints for smallholder entrepreneurship in Africa: the case of soil fertility in Northern Ghana. *Current Opinion in Environmental Sustainability*, 4:489-496.

Reference ID: 22855

Notes: #22855e

Abstract: Effective poverty reduction in Africa requires enabling more smallholder farmers to move from subsistence farming to a more entrepreneurial fashion of farming. Earlier studies showed that smallholders are constrained in doing so because of lack of incentives, high risks, production problems and lack of an entrepreneurial mindset. Deterioration and improvement of the natural resource base impact these

constraints. In this paper we not only focus on soil fertility decline and the available measures to combat this decline but also on the reasons smallholders have for applying them or not. 94% of the 232 smallholders we interviewed in this study report a decline of their soil fertility. During interviews smallholders in northern Ghana gave their reasons for (not) applying the soil fertility enhancing measures manure use, use of household waste, compost making, use of mineral fertilizer, fallowing, improved fallow, use of cover crops, use of human excreta, crop rotation, anti-erosion measures, and non-burning practices. In this paper we evaluate the constraints of implementation of the different soil improvement measures. The most striking conclusion is that implementation of these measures is restricted by the same constraints context that restricts smallholder entrepreneurship in the first place. We therefore argue that, to develop subsistence farmers into more entrepreneurial farmers, support programs are needed that address the entire constraints context for smallholder farmers.

Aguilar-Gallegos N., M. Munoz-Roig, H. Santoyo-Cortés, J. Aguilar-Avila, and L. Klekx. 2015. Information networks that generate economic value: A study on clusters of adopters of new or improved technologies and practices among oil palm growers in Mexico. *Agricultural Systems*, 135: 122-132.

Reference ID: 22856

Notes: #22856e

Abstract: The area under cultivation of oil palm has undergone considerable growth in Mexico, but yields are far below their potential. This is related to the low rate of adoption of new or improved technologies and practices in areas such as plantation management and farm administration. This study determines the factors that have an influence on adoption of new or improved technologies and practices and their relationship with the generation of economic value of oil palm. A cluster analysis of 33 key new or improved technologies and practices adopted by 104 growers was performed, and the main adoption categories and the variables influencing adoption are described. The results indicate that three clusters of growers can be discerned that differ in terms of their levels of adoption. The highest level of adoption of new or improved technologies and practices is related to higher yields and vice versa. The new or improved technologies and practices that differentiate the cluster of the advanced adopters from the cluster of the basic adopters are those related to plantation health, grower associations and production unit management. The cluster of the intermediate adopters is outstanding for their levels of adoption of new or improved technologies and practices in the aspects of plant nutrition, harvest, and genetics and reproduction. The advanced adopters set up better links for getting information, generally from their extensionists. The three clusters each exhibit a great degree of homophily, indicating little information flow between the different clusters of growers, while these can learn from each other. These results make it evident that better articulation among different clusters of growers and other actors should be encouraged, and that diversified and tailor-made extension strategies should be designed to optimally support different clusters of growers.

Bakoume C., R. Wickneswari, S. Siju, N. Rajanaidu, A. Kushairi, and N. Billotte. 2015. Genetic diversity of the world's largest oil palm (*Elaeis guineensis* Jacq.) field genebank accessions using microsatellite markers. *Genetic Resources and Crop Evolution*, 62:349-360.

Reference ID: 22857

Notes: #22857e

Abstract: The extent of genetic diversity among 494 oil palms from 49 populations (representing ten African countries, three breeding materials, and one semi-wild material) were assessed using 16 SSR markers. The genetic diversity was high with a total of 209 alleles detected accounting for an average of 13.1 alleles per locus and a mean expected heterozygosity of 0.644. The average genetic distance among accessions was 0.769, varying from 0.000 to 1.000. Both principal coordinates analysis and neighbor joining tree, confirmed by structure analysis, clustered the entire collections into three groups: the Extreme West Africa (EWA) group (collections from Senegal, Guinea, and Sierra Leone), the West, Central, and East Africa (WCEA) group (collections from Ghana, Nigeria, Cameroon, Zaire, Angola, Tanzania, Bahia, the semi-wild material and the two Deli breeding materials) and the Madagascar group (collections uniquely from Madagascar). Madagascar populations were found to be genetically distinct from all other African populations. The influence of human and environmental factors might have played a major role in grouping the African natural oil palm into three different groups as well as in the formation of a transition zone (formed by Ghana and Cte d'Ivoire). Further analysis of genetic structure revealed Deli materials as a distinct population within the WCEA group. Given the fact that accessions were exchanged between the EWA and WCEA groups, intra- and inter-group combinations for breeding should be based mainly on the genetic distance between accessions to increase yield and heterosis.

Nurulita Y., E. M. Adetutu, K. K. Kadali, D. Zul, A. A. Mansur, and A. S. Ball. 2015. The assessment of the impact of oil palm and rubber plantations on the biotic and abiotic properties of tropical peat swamp soil in Indonesia. *International Journal of Agricultural Sustainability*, 13:150-166.

Reference ID: 22858

Notes: #22858e

Abstract: Current intensification of agricultural activities in Indonesia has led to increased use of tropical peat swamp forests for agriculture. Ideally, peat swamp ecosystems should not be disturbed as they provide essential services such as soil erosion control, ecosystem stabilization and moderation of climate and energy fluxes as well as reducing carbon emission and conserving biodiversity. In this study, agricultural land from Giam Siak Kecil-Bukit Batu Biosphere Reserve in Indonesia was evaluated to assess the impact of oil palm (burning and without burning) and rubber (5-10 and >40 years old) plantations on soil properties through comparisons with soils from a natural forest (NF). Substantial changes in the physico-chemical properties of soils from both plantations were observed including significant reductions in soil organic matter (4-18%) and water holding capacity (22-53%), but an increase in bulk density (ρ_b) (0.08-0.17 g cm⁻³). A significant increase in bacterial biomass was also observed following conversion of the NF to plantation ($p < 0.05$). However, the oil palm plantation (OPP) (without burning) showed reduced microbial activities and the lowest Shannon diversity values (2.90) compared to other samples. Community-level physiological profiling showed impaired community function only in soils from the OPP but higher CO₂ exchange rates in most plantation soils. Soils from the rubber plantation (RP) were less impaired in terms of their natural function and therefore RPs appeared to be more suitable for sustainable agricultural use than OPP.

Yemadje R. H., T. A. Crane, R. L. Mongbo, A. Saidou, H. A. Azontonde, D. K. Kossou, and T. W. Kuyper. 2014. Revisiting land reform: land rights, access, and soil fertility management on the Adja Plateau in Benin. *International Journal of Agricultural Sustainability*, 12:355-369.

Reference ID: 22859

Notes: #22859e

Abstract: In the oil palm-based cropping system on the Adja Plateau, land titling plays an important role. Landowners argue that oil palm fallow (dekan) restores soil fertility, but in the long-term it is also an instrument in the struggle for control over land. A land-titling programme in the study area allowed an analysis of the relationship between titling and soil fertility management that showed two different institutional effects with socio-technical consequences. Titling increased land security for landowners and, although this security initially reduced access to land for tenants, a subsequent introduction of witnessed paper-based contracts enhanced tenants' access to land and improved their security of tenure. Improved titling and more secure tenure reduced conflicts over land and opened possibilities for agricultural intensification. This change was associated with a shift from long-term oil palm fallow to shorter-term land-management practices where tenants and landowners increasingly invested in land through rotations between maize and cowpea (rather than maize mono-cropping) and the use of mineral fertilizers, without increased use of household waste. The paper suggests that sustainable agricultural intensification requires institutional changes, based on a mixture of customary and formal rules, in both landownership and rental agreements to access land.

Carron M. P., M. Pierrat, D. Snoeck, C. Villenave, F. Ribeyre, Suhardi, R. Marichal, and J. P. Caliman. 2015. Temporal variability in soil quality after organic residue application in mature oil palm plantations. *Soil Research*, 53:205-215.

Reference ID: 22860

Notes: #22860e

Abstract: Despite the dramatic changes in land-use arising from expansion of the palm oil industry, soil biodiversity in oil palm plantations has been little investigated. The present study aims to assess the effect of organic waste recycling (empty fruit bunches, EFB) on soil biodiversity in a mature plantation in Sumatra, Indonesia. A chronosequence was delineated taking into account the time between the applications of EFB and soil sampling; intervals of 1, 3, 6, 12, 18 and 24 months were compared with control plots without EFB application. Soil physical and chemical characteristics and macrofauna and nematofauna populations were analysed. The findings highlighted three distinct periods: a first disturbance period (0-6 months) showing a marked increase in pH, potassium content, base saturation and macrofauna abundance, especially ants, whereas earthworm, millipede and nematode populations were substantially reduced; a resilience period (6-18 months); and a final period (18-24 months) showing an improvement in most soil fertility parameters and a high density of earthworms, millipedes and nematodes. The impact of EFB application on soil quality changed as a function of time, and the present results explain the apparent discrepancy of some previous published results. This research is the first stage towards developing new strategies for enhancing soil biodiversity and related services for sustainable oil palm cultivation.

Akpo E., T. J. Stomph, D. K. Kossou, and P. C. Struik. 2014. Growth dynamics of tree nursery seedlings: The case of oil palm. *Scientia Horticulturae*, 175:251-257.

Reference ID: 22861

Notes: #22861e

Abstract: Tree seedling survival in the field partly depends on management during seedling production. Insight into how nursery practices affect seedling growth dynamics would generate understanding in how to optimise tree seedling production. The objective of this study was to analyse the growth dynamics of oil palm seedlings to evaluate the effects of bag size, substrate type, and fertiliser supply, and their interactions. An experiment was run in 2011 (March to November 2011) and repeated in 2012 (April to October 2012) using three bag sizes, four substrates, and three levels of fertiliser supply (3 x 4 x 3 factorial design). Seedling height, collar diameter and number of leaves were measured overtime. Seedling growth was analysed by comparing treatment effects at monthly intervals. Data were also fitted to growth curves to analyse treatment effects on absolute and relative rates of increase in seedling height, collar diameter and number of leaves. While substrate and fertiliser supply effects were fairly constant over time, bag size effects increased with larger variance explained over time. We observed that bag size effects overtook substrate, fertiliser and interaction effects from about two months onwards. Seedling height and collar diameter followed an exponential growth while number of leaves increased linearly overtime. Analysis of generated data with the different growth models indicated that seedling growth rates were mainly under the influence of bag size, followed by substrate. Interactions between nursery practices, although significant sometimes, did not account for a large part of experimental error. Implications for tree seedling management are further discussed.

Mukherjee I. and B. K. Sovacool. 2014. Palm oil-based biofuels and sustainability in southeast Asia: A review of Indonesia, Malaysia, and Thailand. *Renewable and Sustainable Energy Reviews*, 37:1-12.

Reference ID: 22862

Notes: #22862e

Abstract: By extensively reviewing the current state of knowledge, this paper explores the sustainability implications of palm oil biodiesel in Southeast Asia, with a focus on Indonesia, Malaysia and Thailand. Both ecological and environmental vitality as well as socio-economic equity are emphasized in the authors' exploration of sustainability in the three country cases. The article observes that the main environmental sustainability considerations of palm oil biodiesel include its capacity to reduce carbon dioxide emissions, its carbon debt and its repercussions on forestry, biodiversity, and soil and water quality. Issues surrounding socio-economic sustainability encompass how palm oil biodiesel affects food security in Southeast Asia, along with the impact of palm oil production on rural livelihoods and land-tenure. The authors firstly explore the origins, drivers and current technologies surrounding palm oil biodiesel development in the region. They then present the three country cases in order to concentrate on the particular policies, challenges and opportunities that uniquely impact the sustainability of biodiesel development in each locale.

dos Santos J. W. G., F. F. F. Hernandez, B. F. de Aquino, F. N. da Silva, D. C. dos Anjos, and J. T. P. Ferreira. 2014. Reply of Banana (*Musa* sp.), Pacovan in Management Systems with Application of Mineral Fertilizer and Biofertilization: RESPOSTAS DA BANANEIRA (*Musa* sp.), CULTIVAR PACOVAN EM SISTEMAS DE MANEJO COM APLICAÇÃO DE FERTILIZANTE MINERAL E BIOFERTILIZANTE1. *Revista Caatinga*, 27:142-152.

Reference ID: 22863

Notes: #22863e (in portuguese)

Abstract: The liquid biofertilizers have been used with relative success in the recovery of banana plantations that have low productivity, after long time cultivation. However, there is little information available related to cultural practices that aim to increase the life of bananeiral. The objective of the present study was to compare areas degraded plantations that have received the application of biofertilizer for a period of two and five years and the area where the culture did not receive this type of application. The study was conducted in year of 2011 in the municipality of Chapada do Apodi Quixere-CE. It was evaluated the effects of time of application on soil chemical attribute, biometric measurements of the plant, dry mass production, extraction and export of N, P and K, and the contribution of plant biomass. The experimental design was completely randomized with three replications. The biofertilizer increased the content of organic matter, exchangeable Ca and K in all soil depths. The levels of disposable P and exchangeable Mg were higher only in the surface layer. The biofertilizer contributed to the increase of pH, the CE and Na soil. Plants that received application of the product were higher, with greater weight and number of leaves. The area received more application time showed higher productivity, accumulated 20% more dry mass, extracted more N, P and K soil, more nutrients exported through harvesting and landed larger amount of plant biomass.

Pan N., H. Shen, D. M. Wu, L. S. Deng, P. F. Tu, H. H. Gan, and Y. C. Liang. 2011. Mechanism of improved phosphate uptake efficiency in banana seedlings on acidic soils using fertigation. *Agricultural Water Management*, 98:632-638.

Reference ID: 22864

Notes: #22864e

Abstract: Fertigation improves nutrient uptake efficiency greatly, while the mechanism of increased nutrient uptake efficiency remains unclear. In this study, the effects of conventional phosphate (P) fertilization (by mixing fertilizer with soils) and fertigation (by dissolving fertilizer in water) on P uptake were compared in banana (*Musa sapientum*) seedlings. Results indicated that, compared with conventional fertilization, fertigation increased the concentration of available P by 108% and decreased the P sorption index by 31% in the 0-8 cm surface soil of banana roots. Fertigation enhanced the transformation of different P fractions, increased the concentrations of aluminum-bound P (Al-P), iron-bound P (Fe-P) and occluded-P (O-P), and decreased the pH value by 0.3 units. However fertigation did not influence the activity of acid phosphatase, but increased microbial biomass and root activity by 25.5-67.8%. Furthermore, fertigation increased the root distribution in the 0-8 cm soil layer by 7.8-9.4% compared with conventional fertilization. These results suggest that fertigation increases P uptake efficiency as the result of increased root activity, root distribution, microbial biomass and reduced P sorption index in the surface soil of banana seedlings.