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FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION
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ITC NEWS

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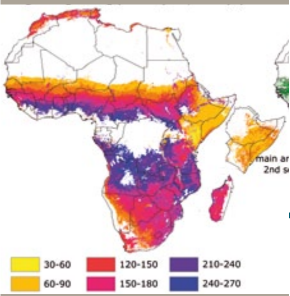

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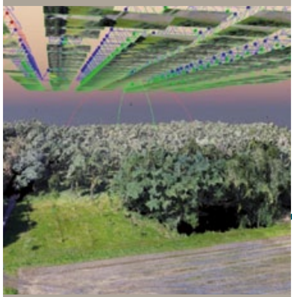

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Content

Food and many other products that we use are, or contain, components derived from biomass and we all want these products to be produced safely. This means we produce them in a way that is not harmful for our environment or for people. Melese Firrisa looked at energy efficient rapeseed, a dedicated energy crop grown all over Europe, as input for biodiesel production. This research showed that we have to be careful where we grow rapeseed for biodiesel and where not.

INTRODUCTION

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To come straight to the point, the core theme of the ITC News 2017-2 is certification. *Certify your future* says ITC staff member Iris van Duren in her introduction using geo information for sustainable production (page 3). The workshop entitled *"Geo Information for Sustainability Assessments"* organized by Iris is the main contributor of this issue. Certification procedures have proven to be a reliable tool therefor proven the importance using for example the International Sustainability and Carbon Certification System which is the largest of several certification schemes approved by the European Commission (page 6). In the context of sustainability it is also important to know when for example palm oil plantations are expanding and affecting areas of high biodiversity or virgin rain forest. You can read the story of Christine Pohl about the Production of sustainable palm oil on page 10. As you can read this topic is broad enough for a special feature of 19 pages in this ITC News magazine.

Furthermore we receive the greetings from yet again an ESRI intern who is working for the 3D scene layers team focusing on designing solutions and implementing scene layers for the well know ArcGIS platform. As ITC alumni are entitled to receive a licence for ArcGIS you will personally get to know the work of ITC alumna Yunmeng Zhu (page 26). If you do not have a licence yet I refer you to the ITC alumni webpages to fetch your licence code!

As the year passes by we had the honour to receive the Surveyor General of Nepal and ITC alumnus Ganesh Prasad Bhatta (page 25) and as well received the notification that ITC alumnus Hon Dr Wilbur Ottichilo was elected Governor of Vihiga County (Kenya, Page 22). Potential, current and past students must find their stories great examples of what you can become after your graduation at ITC. And so a new publication rolls off the press, bringing you up to date with the latest announcements and happenings in fields that are of interest to us all. Words to conjure with, pictures worth a lifetime… but when all's said and done who's counting? We simply invite you to sit back and enjoy this latest issue of *ITC News* – and perhaps be inspired to share with your fellow readers reports of projects, internships and research that are planned or underway in your own part of the world.

Virtually yours,

Jorien Terlouw
Editor

Special Feature

Certify our Future

Food and many other products that we use are, or contain, components derived from biomass and we all want these products to be produced safely. This means we produce them in a way that is not harmful for our environment or for people. The main challenge these days is how to make sure we really do this and how to design sustainable supply chains. I'm very much convinced that sustainability certification is part of the solution. That is why I organized, a workshop on "Geo Information for Sustainability Assessments" in ITC on 13 June. In this special issue of ITC News, several participants will introduce themselves and share some of their work and ideas.

Geo Information for Sustainable Production

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Sustainability certification

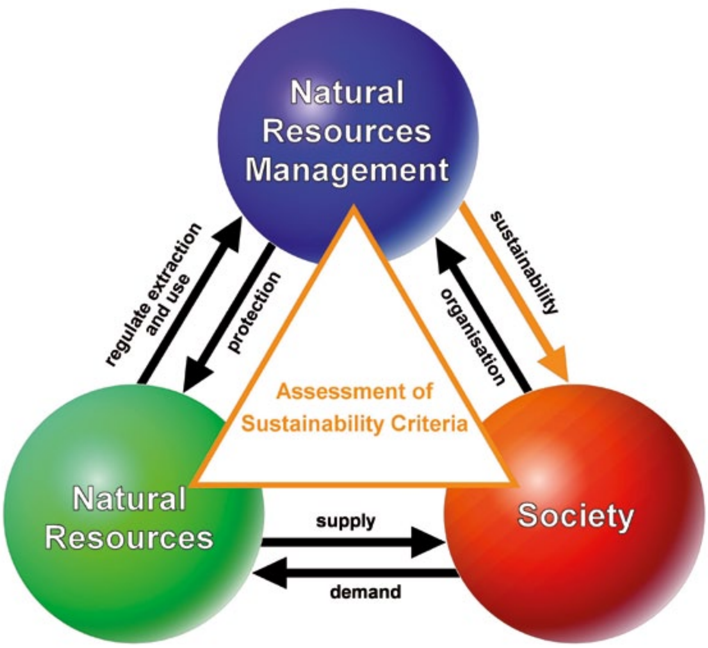
Sustainability certification makes use of a standard. This standard describes when production methods, use and disposal of products are good and when not. Assessments, done by an independent assessor, reveal if a product or a producer meets the requirements of the standard. And "yes" there are still quite a number of hurdles to take and not everything works as we like. But I definitely see certification as an important step in the right direction.

My personal drive to contribute

For me, the issues around sustainable production really came alive during a campaign of the World Wide Fund for Nature (WWF) in the Netherlands. As a volunteer for WWF, I was exposed to a number of serious and quite shocking environmental and social problems related to the production of palm oil. Palm oil is a vegetable oil produced from oil palm fruits. It has many applications in the food industry and besides that it is also used for other purposes such as the production of soap, cosmetics and biodiesel. Unfortunately, in the last decades many things went wrong with establishing and expanding oil palm plantations. Forest fires, biodiversity loss due to forest loss and forest fragmentation, destruction of peatland causing greenhouse gas emissions, land grabbing and pollution are just a number of the impacts that we do not want. The spatial context and power of using remote sensing and GIS to locate and quantify these impacts inspired me to link my ITC research work and teaching to the context of sustainable production of palm oil.

ITC students assessing sustainability of palm oil production

Several students (now alumni) made valuable contributions in the search for reliable and accurate methods, data and tools to assess sustainable palm oil production. Lelyana Midora graduated in 2009 on the use of MODIS NDVI to detect land cover changes in so-called "High Conservation Value Forests". This is strictly forbidden according to the standards for sustainable palm oil



My personal view on how sustainability certification is part of Natural Resources Management. *Source: Iris van Duren* production. In the same year Bhawna Sharma modelled carbon stocks in oil palm plantations. It is, of course, important to know what we will gain, what we will lose and how we will influence the carbon cycles when we change our ecosystems from forest to oil palm plantation. Isaac Nooni mapped oil palm plantations in Ghana with a specific classification technique called "support vector machine", while Abel Chemura managed to estimate the age of oil palms based on object-oriented image analysis of high resolution imagery. Both Isaac and Abel managed to publish their MSc research in scientific journals, which is a great achievement. We will also try this with the research work of Ditte Trojaborg, whose work on automated detection of smallholder oil palm will be explained by herself in a separate article (page 13).

From palm oil to "bio-based"

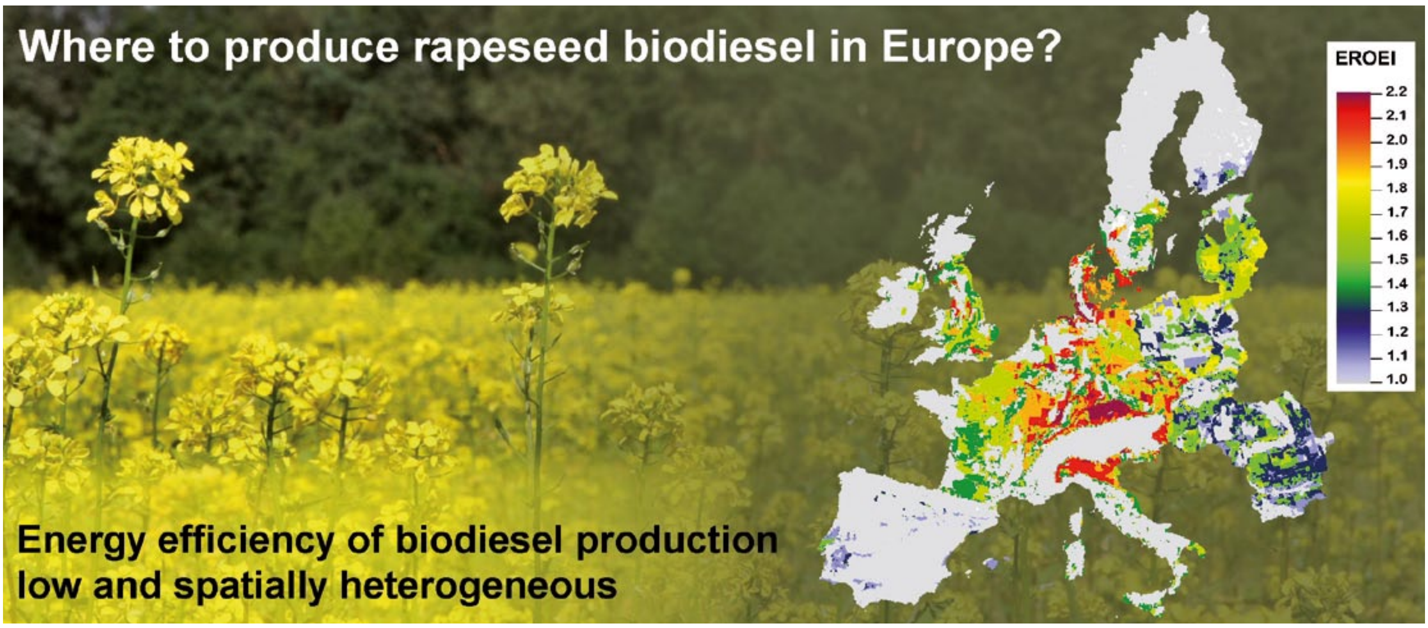
It started with oil palms, but my interest expanded also to other crops and to "sustainable biomass" in general. I was, for instance, very much intrigued by the many claims and even more by the many believers that bioenergy is a sustainable source of energy. Words such as "bio", "green" and "bio-based economy" give consumers the feeling that they buy something good and sustainable and the energy sector makes use of this in a clever way. They also have a strong lobby on National, EU and global policy level, enabling them to develop business cases. But I am frequently not convinced that their claim of sustainable production can stand the actual test of sustainable production. That remains to be seen. In that light, a whole series of new topics for MSc research came up.

Bioenergy sustainable? This needs careful evaluation.

Together with colleague Alexey Voinov, I supervised a number of MSc studies of which many also ended up in scientific journals. Brandon Wysowsky mapped carbon stocks of roadside vegetation and Lin Qin provided relevant input to estimate the potential of roadside vegetation for bioenergy production. Oludunsin Arodudu and Shupel Ibrahim explored bioenergy potentials and energy efficiency for built-up areas and rural areas, taking biomass waste material as input for the production process. Melese Firrisa looked at energy efficient rapeseed, a dedicated energy crop grown all over Europe, as input for biodiesel production. This research showed that we have to be careful where we grow rapeseed for biodiesel and where not. Land preparation, fertilization and crop protection in less favorable areas may cost so much energy that sometimes the energy investments hardly gain energy, or even worse, are higher than the amount of energy produced. We need to fully understand the impact and assess sustainable production of biomass.

Geo-information for sustainability assessments

Over the past years, I came in touch with ISCC. This stands for International Sustainability and Carbon Certification which is a standard acknowledged by all EU member states and they grow and operate globally. In the same building in Cologne, Germany, the team of Global Risk Assessment Services can be found. When I went there for the first time with my colleague Tom Loran to see what ISCC was about, I met Norbert Schmitz, Jan Henke, Mohammad Abdel-Razek and many others, I felt that this group of dynamic people is open-minded and that they were moving in a direction where I also wanted to go. They are eager to further develop remote sensing and GIS-based methods to assess various sustainability criteria with a spatial component. Examples are undesired land cover changes, use of fire for land preparation or impacts on areas with a high conservation value. Since one and a half year ITC has been an official member of ISCC. More or less simultaneously, I found out that former ITC colleague Christine Pohl, currently working at the University of Osnabrück, also has similar interests. All came together when ISCC offered an internship for an ITC student. Ditte Trojaborg took the opportunity and did a great job in combining her research work with research that was also relevant for ISCC. Christine acted as external examiner



Graphical abstract of the study energy efficiency of growing rapeseed for biodiesel in Europe
(van Duren et al., 2015, Renewable energy, 74 pp. 49-59)

during the MSc defence of Ditte which was planned on the same day as part of the workshop. In the plenary session of the workshop we further identified in what way we can join forces.

What's next? After the contextual and technical presentations in the workshop, we closed off with a plenary discussion. The audience was divided into small teams and in the room six flip charts with different questions were put up. At high speed, each team gave answers to these questions. Next, each person could prioritise the points listed on the flip charts. We have summarised these points and soon we will look at how to put these action points into practice. It is an ongoing process, but I feel we are moving ahead and it is fun to work together in this way. Hopefully, after reading the other articles in this special issue, you are inspired by what is going on. If you feel you can also contribute, please, do not hesitate to contact me. ■

> I was very much intrigued by the many claims and even more by the many believers that bioenergy is a sustainable source of energy

Slide presented at the workshop to express the need for sustainability certification for products such as palm oil

Group picture at the end of the plenary session of the workshop

ISCC – Spatial Information Needs for Certification

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The Paris Agreement on limiting global warming within this century to well below 2°C and the Sustainable Developments Goals (SDGs) established by the United Nations[1] have set new standards for the development of the global economy. Climate protection and a sustainable development of poor as well as rich world regions require stronger efforts to protect social needs and obey ecologic boundaries.

Monitoring, reporting, and verification (MRV) of these efforts in a strongly interlinked world economy requires new tools. So far, the sustainability of biomass supply chains is hardly subject to MRV measures. One important exception is the requirement of the European Union in its biofuel mandate to accept and count only those biofuels to the target which have been subject to a sustainability certification. The International Sustainability and Carbon Certification System (ISCC) is the largest of several certification schemes approved by the European Commission.
The options for reducing greenhouse gas emissions for meeting the objective of the Paris Agreement have been thoroughly analyzed by the IPCC[2]. One of the fundamental insights of this report is the need for so-called negative emissions in the second half of this century. This is the case because it is impossible to avoid all GHG emissions entirely, therefore some of the GHG emissions still taking place need to be compensated for by negative emissions. Finally, at the end of the century there will have to be net-negative emissions, meaning that the negative emissions need to be higher than the remaining GHG emissions, e.g. from agriculture or transport. This means that some of the CO^2 in the atmosphere needs to be taken back and stored on the earth, either on land or below the oceans. One way of achieving negative emissions is through the use of biomass in combination with carbon capture and storage (CCS). One particular way would be to use biomass for producing energy products such as heat, biofuels, or electricity, while simultaneously capturing and storing the process emissions – the CCS part - to get the so called BECCS (bioenergy with CCS). Other options include the large scale afforestation of large areas of the earth or the direct capture of CO^2 with technical devices.

Currently, the UN within the SDG framework is developing a system of MRV. It will encompass many social, ecologic, and economic indicators that can indicate the progress towards sustainable growth in the world. Several refer to agriculture, rural people, and biomass use. The SDGs ask, among other things, for providing income to rural households, raising yields, conducting responsible agriculture, and protecting smallholders, but also for maintaining well-functioning ecosystems. Despite this commitment, not all countries currently possess the legal framework and the institutional capacity to easily implement the measures necessary to meet the SDGs within their own jurisdiction. Many emerging economies and developing countries face such problems but, at the same time, are important exporters of many types of biomass. Since biomass has become a globally traded commodity, it is in the interest of producers as well as consumers to be informed about the sustainability of their products consumed or produced.

Biofuel certification – The test case for sustainability assessments

Currently, the only bio-based products that are subject to clearly defined sustainability standards are biofuels which are to be sold within the European Union. In fact, it is only those biofuels which can be counted against the European Union's biofuel quota by the mineral oil companies. Since biofuels would not be brought to the market without the quota system, practically all biofuels are subject to the sustainability requirement. Many large food companies have developed internal standards for their global sourcing of raw materials and processed products. However, much of the market is not covered by rules and standards for achieving sustainability. Theoretically, this can be done by local authorities close to the place of production, e.g. the farm or processing plant. However, given the dispersion of agricultural production, the different requirements of demand across the world, and limited local human, financial as well institutional resources to provide such services, sustainability standards are often set and implemented in the importing countries, if at all.

Once sustainability standards are set, the appropriate monitoring, reporting and verification (MRV) system needs to be put in place to make sure that the information about the sustainability or unsustainability of a product can be generated and is credible. Monitoring can be done by local authorities close to the place of production, e.g. the farm or processing plant. However, given the dispersion of agricultural production and the different requirements of demand across the world monitoring and reporting would often be too complex and costly. Fortunately, modern technologies of

[1] United Nations (2015): „Transforming Our World: The 2030 Agenda for Sustainable Development", A/RES/70/1, https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

[2] IPCC, 2014: *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

remote sensing can drastically reduce the cost and increase the accuracy of monitoring land use decisions by farmers. The technology for an accurate and timely observation of land use and biomass growth is available. Bringing this technology to practical use requires additional effort in converting the remote sensing data to useful information for the reporting and verification of sustainable agricultural practices.

The Renewable Energy Directive (RED) of the European Commission has defined sustainability standards for biofuels and has provided the framework for certification systems to perform sustainability assessments.

How does ISCC certification work?

ISCC is a stakeholder-driven certification system that has originally been designed for certifying biofuels along the complete supply chain. It encompasses ecologic as well as social aspects, thus going beyond the basic requirements of the RED.

By now, ISCC has system users in more than 100 countries and has issued over 14 thousand certificates. ISCC has also expanded beyond the certification of biofuels and offers sustainability certification for all biomass based products such as food, feed, or biomass for industrial uses (figure 1).

The certification process goes as follows: A farm or company signs up with ISCC for certification. It then asks a certification firm that is accredited by ISCC to perform the audit. The audit report is the document which determines whether a certificate will be granted by ISCC. In the audit the certification body checks in detail whether the 6 ISCC principles are fulfilled (figure 2).

A biofuel – or any other biomass based product - that will be sold to the final customer should only be declared a sustainable biofuel if the complete value chain of that biofuel has been subject to certification. This means, certification needs to take place at the farm level, the processing plants, and the storage and trading operators. Despite the fact that the amount of certified biomass based products is still very small, it is clear that a large amount of data need to be gathered. Since the major focus of certification, both in terms of social as well as environmental challenges, is the farm level where the biomass is produced. This is already a time consuming and thereby costly, even though only a small proportion of global biomass production is subject to sustainability certification. ISCC is, therefore, using risk assessment tools to reduce the on-site time for auditors and to improve the accuracy of the audits. For example, in terms of the climate objectives, the issue of land use change is an especially important aspect for which spatial information is crucial, whether it is done physically by the auditor on-site or remotely with satellite images. Given the large number of farms that are already subject to ISCC certification not every detail of sustainability aspects on the farm level can be assessed. Therefore, an assessment of risks of land use change can strongly reduce the auditing intensity. The GRAS Tool (page 8) is a very helpful means of risk assessment, both for auditors and for operators.

The upscaling challenge

Given the fact that currently only a few biomass value chains, in particular those for biofuels consumed in the EU, undergo a thorough sustainability certification, the MRV of a positive or negative impact of biomass production on the SDGs or for the objectives of the Paris Agreement is very limited. In order to have an impact beyond those niche markets, the MRV needs to be expanded from thousands of agricultural activities to hundreds of millions of farms. Certification procedures have proven to be a reliable tool which not only have led to reporting of the status quo, but also to significant improvements of ecologic and social conditions on the farms. However, without new advanced assessment tools a global MRV of biomass production and use will not be possible with appropriate accuracy and at reasonable cost. Using the new opportunities of remote sensing will make global sustainability certification feasible, effective and efficient. ■

Figure1: ISCC has also expanded beyond the certification of biofuels and offers sustainability certification for all biomass based products such as food, feed, or biomass for industrial uses

PRINCIPLE 1	PRINCIPLE 2	PRINCIPLE 3
Zero deforestation Protection of primary forests, high carbon stock areas, peat- and wetlands, protected areas and highly biodiverse areas	**Good agricultural practice** Agricultural and forestry production shall protect soil, water and air and ensure a sustainable use of land	**Safe working conditions** Ensure workers health and safety during work. Improve competence and knowledge via training
PRINCIPLE 4	**PRINCIPLE 5**	**PRINCIPLE 6**
Social conditions Ensure good labor conditions and limit impacts to surrounding communities	**Compliance with laws** Comply with all regional and national laws and international treaties	**Good management practices** Recording system and compliance of subcontractors

Figures 2: In the audit the certification body checks in detail whether the 6 ISCC principles are fulfilled

GRAS: a Tool for Implementation of no-Deforestation Policy and Monitoring Sustainability

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The need to protect forests for the preservation of high conservation value and the mitigation of climate change is indisputable. Stakeholders pressure companies along the value chains from a plantation and processing level all the way to consumer goods companies, retailers and brand owners to stop deforestation. They demand a verifiable implementation of deforestation-free supply chains. NGOs and more and more companies in the food sector do not accept so-called "book and claim" approaches any longer, they are considered as a green washing exercise.

As a result, many companies have published their sustainability and no-deforestation policies and commitments. However, the latest report by Greenpeace shows that when it comes to deforestation-free palm oil, most of the multinationals are still failing to deliver on their promises.

This has been accompanied by moves by investment and wealth funds to drop certain companies over links to deforestation and demand increasing commitments to sustainability and ending deforestation.

Reasons for not reaching the no-deforestation targets are manifold. Among other things, they include the complexity of supply chains, lack of incentives, limited access to reliable information on Land Use Change (LUC) and deforestation as well as the limitation of existing monitoring and reporting approaches.

Verifying and monitoring sustainable agriculture and forestry is not easy. Mostly because it's difficult to access comprehensive, reliable and geo-referenced data on factors like biodiversity, carbon stock and social issues. In particular LUC, e.g. conversion of forests, peatland or grassland to agricultural crop/plantation land is hard to monitor. Therefore, it is difficult to guarantee deforestation-free supply chains, to conduct risk assessments and to picture LUC over time.

However, we at Global Risk Assessment Services (GRAS) – a web platform and consultancy firm – believe that companies can currently achieve more. Implementation, monitoring and reporting tools to credibly reach the target of deforestation-free supply chains are available.

One such solution is the GRAS tool – an innovative and easy-to-use online tool that can detect LUC – through an automated system of satellite monitoring, developed in collaboration with experts from the German Aerospace Centre (DLR).

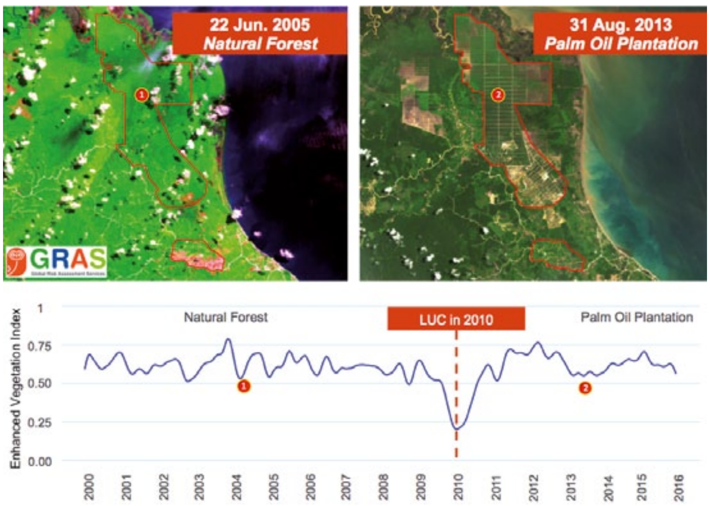


Figure 1 Forest converted to a palm oil plantation in Indonesia

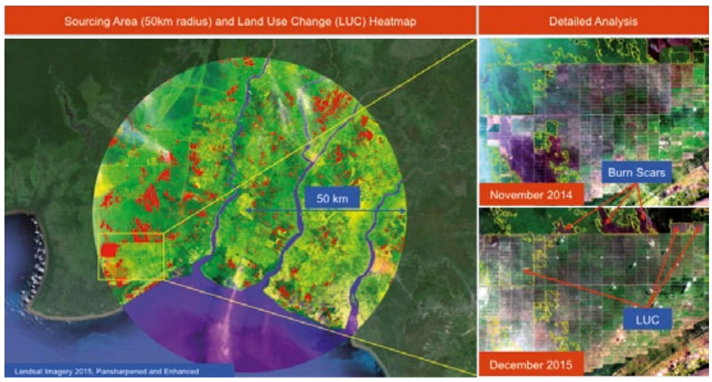


Figure 2 Heat map showing LUC in a sourcing region in Borneo

GRAS provides comprehensive sustainability-related information on biodiversity, carbon stocks, LUC and social indices that you can see by clicking on different overlapping visual layers. Information has been compiled in cooperation with the University of Illinois at Chicago, The Nature Conservancy, The Welthungerhilfe and the Kiel Institute for the World Economy.

GRAS offers analysis of up-to-date satellite imagery, without the need for remote sensing expertise, so that users can identify areas of forest or grassland that have been converted into agricultural cropland and plantations. GRAS can increase the confidence of companies and investors that biomass is being produced in a sustainable manner, while allowing companies and NGOs detection of those producers where unsustainable LUC took place.

The GRAS web tool goes beyond the simple display of LUC maps. Companies can verify the occurrence of LUC within sourcing areas or on individual farms and plantations. They can use an easy to interpret, yet powerful, green cover index called the Enhanced Vegetation Index (EVI). With EVI data on the vegetation cover dating back to 2000, one can differentiate among different types of green cover, monitor land use over time, and most importantly detect land use change. EVI data can detect deforestation, replanting activities, grassland conversion and cropping activities. Agricultural companies, traders and certification systems already use GRAS to verify deforestation-free palm oil plantations and soybean oil production and supply chains.

The following examples demonstrate how GRAS can be used to identify LUC over time. The first figure shows where natural forest was removed and replaced with a palm plantation. Therefore, proving this plantation was not deforestation-free prior to 2011 (figure 1).

The second figure shows how GRAS can identify the risk that land has been deforested and can actually map LUC in entire sourcing areas and also analyse in detail what type of LUC occurred (e.g. forest to plantation or just replanting of plantation or burning). Such analysis allows companies to verify the sustainability of plantations where they source agricultural or forestry commodities from, and enables them to monitor and analyse high risk plots in detail (figure 2).

These examples show how GRAS can serve as a much-needed solution to help ensure sustainable and deforestation-free production and supply chains. Compared to existing tools, GRAS includes current and detailed data on LUC and allows a customized analysis of LUC and sustainability issues, which also includesbiodiversity, social and carbon information on the ground, in a 4-step approach from sourcing area to farm level (figure 3).

The 4-step approach has also been used to support sustainability certification schemes like ISCC (International Sustainability and Carbon Certification) in estimating first gathering point risk levels, farmers with higher risks and is used for farm auditing and monitoring.

GRAS also offers sustainability dashboards and scorecards that can display such information for individual companies. Further information layers can be added as required. With the GRAS tool the implementation of deforestation-free supply chains is facilitated and fact-based, objective and credible sustainability reporting becomes reality. ■

The GRAS development has been supported by the German Federal Ministry of Food and Agriculture through its Agency for Renewable Resources (FNR)

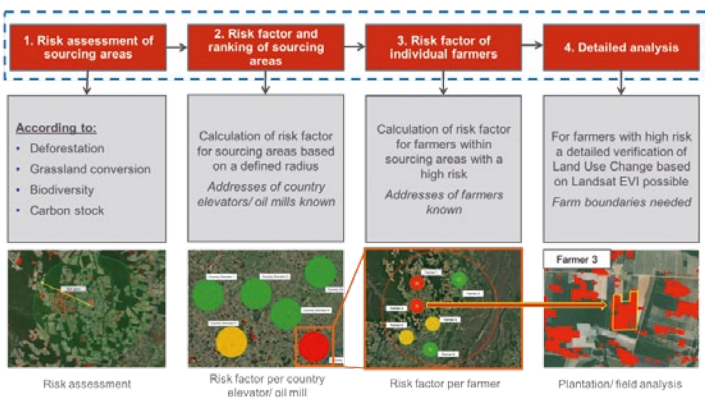
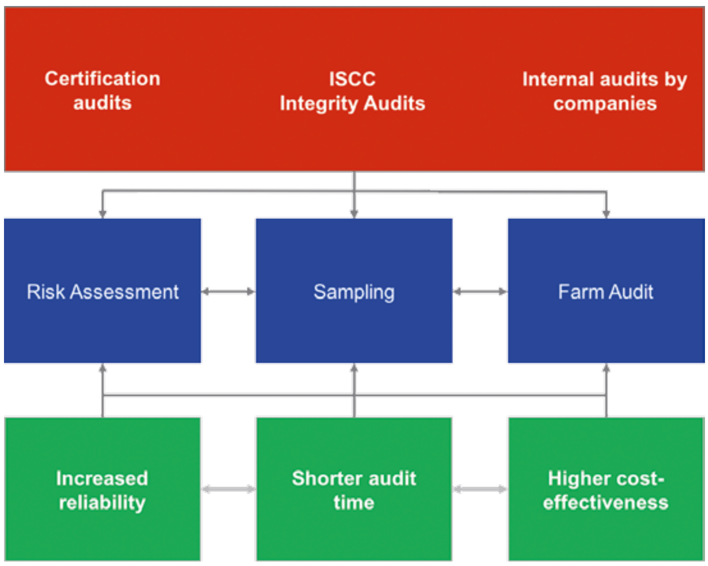


Figure 3 GRAS 4-step approach for implementation of deforestation-free supply chains



GRAS also offers sustainability dashboards and scorecards that can display such information for individual companies

Using Remote Sensing to Support the Production of Sustainable Palm Oil

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The oil palm is producing the highest oil yield among oil seed crops. The leading palm oil producer is Indonesia, followed by Malaysia. The latter has 16% of its land planted with oil palms.To cope with the increasing global demand on edible oil, additional areas of oil palm are forecasted to increase globally by 12 to 19 million hectares by 2050.

Large-scale conversion of natural tropical forest into plantation is a well-known phenomenon influencing effects on climate change, emission of greenhouse gases (GHG) and biodiversity reduction due to the loss of critical habitats for endangered species. Others include soil erosion, as well as air, soil and water pollution. Due to the limited amount of suitable and available land needed to expand oil palm plantations, new strategies have to be developed to avoid unauthorized clearing of primary forest for the use of oil palm cultivation (Pohl and Loong, 2015). Remote sensing plays a major role in providing timely data covering large areas in order to monitor oil palm plantation expansion. With the availability of free satellite data from the American Landsat and the European Copernicus (Sentinels) programs regular monitoring intervals become feasible. Both programs provide multispectral images at different repetition rates. The data needs intelligent image processing methods to extract the necessary information to support sustainability certification bodies, such as the International Sustainability and Carbon Certification (ISCC) and to detect changes in the land use / land cover (LU/LC).

Free remote sensing data

Landsat is the longest operating optical remote sensing program that built up a large archive of remote sensing images starting from 1972. The latest satellite of this series (Landsat 8) acquires eight different channels, ranging from visible and near infrared wavelengths to the thermal domain of the electromagnetic spectrum. It has a 16-day repeat cycle. Together with its

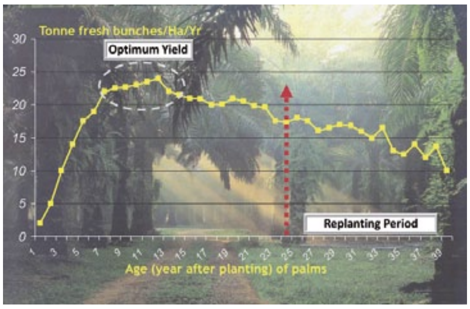


Figure 1: Oil palm yield depending on the age *(Malaysian Palm Oil Board 2017)*

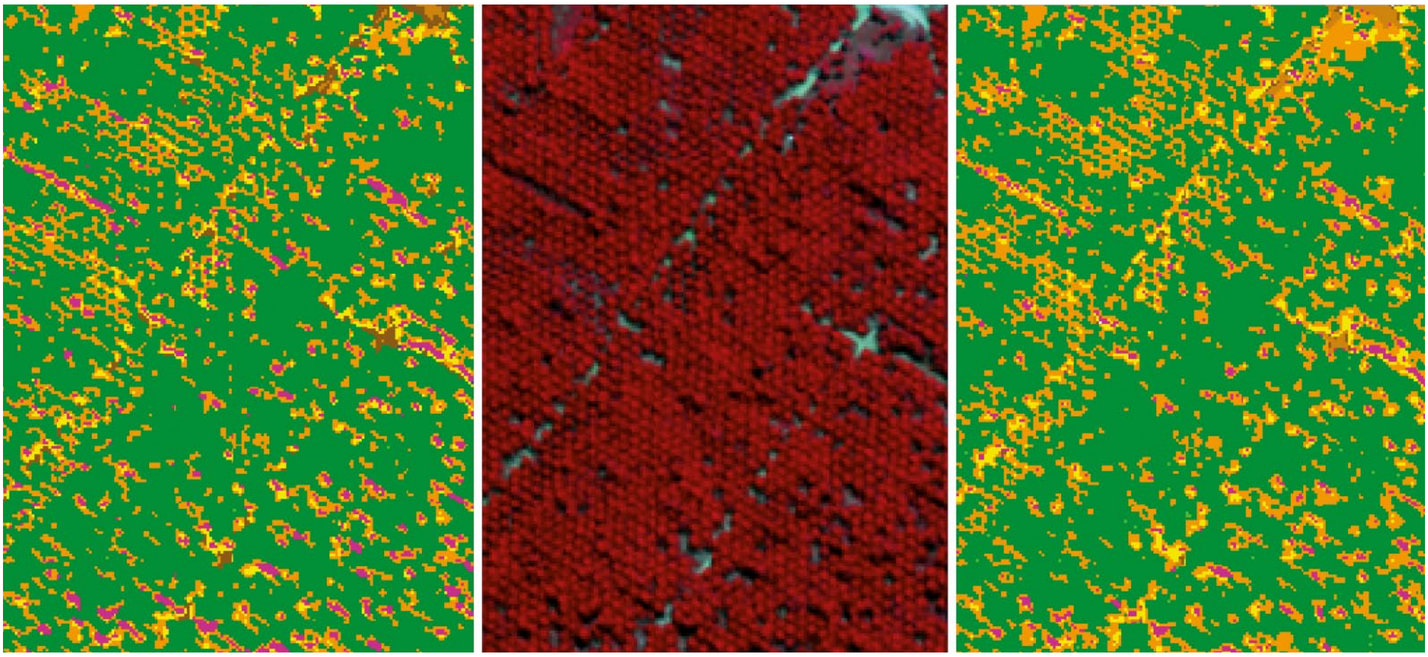


Figure 2: Classification of high resolution imagery using SVM (left) and SAM (right). The centre image is a subset of the WorldView-2 data *(Master thesis Nils Schoen 2017, UOS)*
dark green = oil palm; orange = overgrown soil; purple = tree shadow;
yellow = minimum vegetation; brown = soil; bright green = grassland

Figure 3: Categorization of quality of plantation segments
(Master thesis Nils Schoen 2017, UOS)

predecessor Landsat 7 it can even achieve an acquisition of the same location on Earth every eight days. Since 2014, the European Sentinel satellites were launched into space. Sentinel satellites operate as constellations, which means that each sensor exists on two identical platforms, flying along the same orbit, 180° apart. This leads to the advantage that the repeat-cycle can be reduced by 50%, resulting in a revisit time of five to six days. Vegetation reflects highly in the infrared range while the signal remains low in the visible range. The strong increase in reflectance is called 'red edge'. With additional spectral channels the optical satellites Sentinel-2 provides a few bands along the so-called 'red edge', leading to further details on vegetation. In addition, it has an increased spatial resolution of 10 m ground sampling distance compared to Landsat 7 and 8 with its panchromatic channel at 15 m. The Copernicus program consists of further Sentinels, one of which is an active sensor acquiring radar data (Sentinel 1 SAR). The information contained in a radar image is complementary to optical remote sensing data. Synthetic aperture radar (SAR) sensors do not only provide complementary information to VIR images. The SAR is an active sensor that operates weather and daylight independent delivering information all year round at the time that it is needed. Clouds, haze and smoke do not prevent the sensor from providing images. The challenge in this respect is the different nature of radar data in terms of information content and interpretation. The intensity-backscattered energy of microwaves is sensitive to texture, size and orientation of structural objects, moisture content and ground conditions.

Oil palm research

In the context of sustainability it is important to know if plantations are expanding and affecting areas of high biodiversity or virgin rain forest. In Malaysia mainly plantations on Borneo (Sabah and Sarawak) are further expanding since the peninsular is already 49% covered by oil palms. Therefore remote sensing is a key player in detecting LCLU changes on a global scale. Repetitive observations with large coverage are feasible, especially with the free data policy of Landsat and Copernicus. Using computer-aided analysis the images are processed into information that can be integrated in a geographical information system (GIS) for further analysis. For oil palm plantation delineation optical as well as radar remote sensing is being used. Efforts to contribute to the automation of the process are being undertaken in a collaborate initiative between the Faculty of Geo-information Science and Earth Observation (ITC), University of Twente, the Institute of Computer Science of the University of Osnabrueck (UOS) and ISCC. This includes the evaluation of remote sensing time series to automatically discover the so-called breakpoint when a drastic change occurs, which is then related to an event at that particular location. In the context of oil palm plantations this could be the conversion of forest to plantation.

Efficient use of plantation areas

Another aspect is the support to plantation management to increase the efficiency and reduce environmental impact. Here tree age estimation and tree counting are relevant parameters from space imagery. The age directly correlates with productivity. Oil palm trees are usually cut at the age of 25 because they do not produce sufficient fruit bunches anymore (Figure 1, page 10). Appropriate replanting measures ensure sufficient yield per area to make the most of existing plantations and reduce expansion. The identification of tree growth anomalies from remote sensing has been studied in Osnabrueck by Nils Schoen, Master student. Using state-of-the-art classification algorithms, i.e. the Spectral Angle Mapper (SAM) and the Support Vector Machine (SVM) the researchers developed ways to categorize plantation segments into quality categories. The input data was high spatial resolution WorldView-2 (WV-2) data provided by the University Teknologi Malaysia (UTM) (Figure 2, page 10). Using segments of different growth pattern the quality of planted trees and the efficient use of area within the plantation was categorized (see Figure 3, page 11). The criteria for quality assessment were the percentage of oil palms contained, the amount of overgrown soil and vegetated areas. The scale is depicted in Figure 4.

Age classification of oil palms

Another study concentrated on the automatic classification of oil palm trees into different age classes using image fusion techniques and classification. The research was carried out by André Baldauf, Master student. Based on high spatial resolution data of WorldView-2 provided by UTM the image was sharpened using various fusion algorithms. The pansharpened data was then classified using a Random Forest classification to identify oil palms of different age classes. The plantation area of investigation is depicted in Figure 5. As a result it was found that different fusion algorithms delivered different classification accuracies. With these findings it is possible in future to achieve optimized thematic maps following the established workflow. An example map is shown in Figure 6, a classification result based on pansharpened WV-2 imagery fused by a wavelet algorithm.

GIS to support plantation management

Current efforts of UOS concentrate on the extraction of information from multitemporal Sentinel-2 and Landsat data as free data sources. In particular the change detection in the context of plantation area expansion is of interest. All derived information is supposed to be integrated in a GIS tool to support efficient and sustainable plantation management. ■

Class	Oil palms [%]	Overgrown soil [%]	Tree shadow [%]	Minimum vegetation [%]
Good	> 80	< 15	< 2,5	< 2
mean	> 70 - 80	15 - < 20	2,5 - < 5	2 - < 4
below average	60 - 70	20 - 25	5 - 7	4 - 6
critical	< 60	> 25	> 7	> 6

Figure 4: Quality categories for efficiency evaluation of plantation segments *(Master thesis Nils Schoen 2017, UOS)*

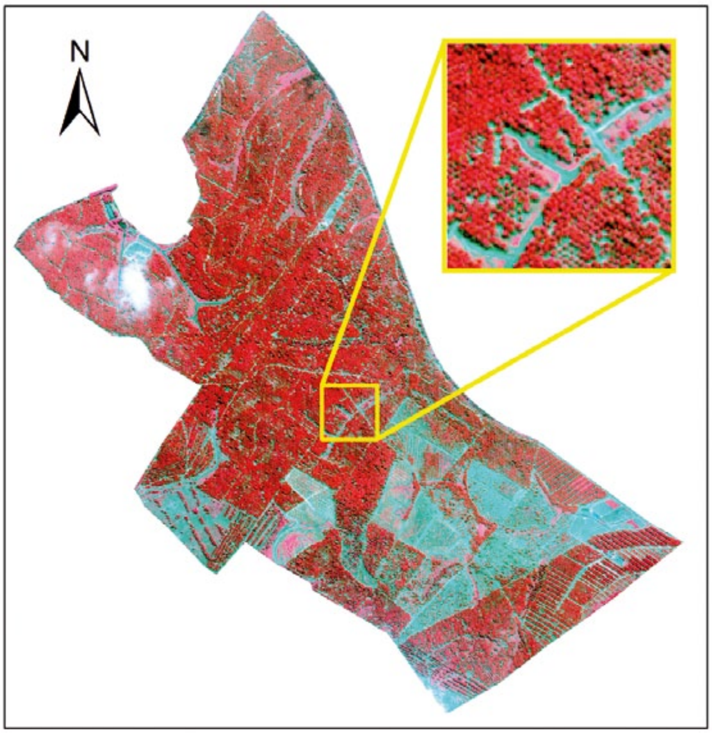


Figure 5: Research Plantation located in the State of Johor, Malaysia as 'seen' by WorldView-2 *(Master project André Baldauf 2017, UOS)*

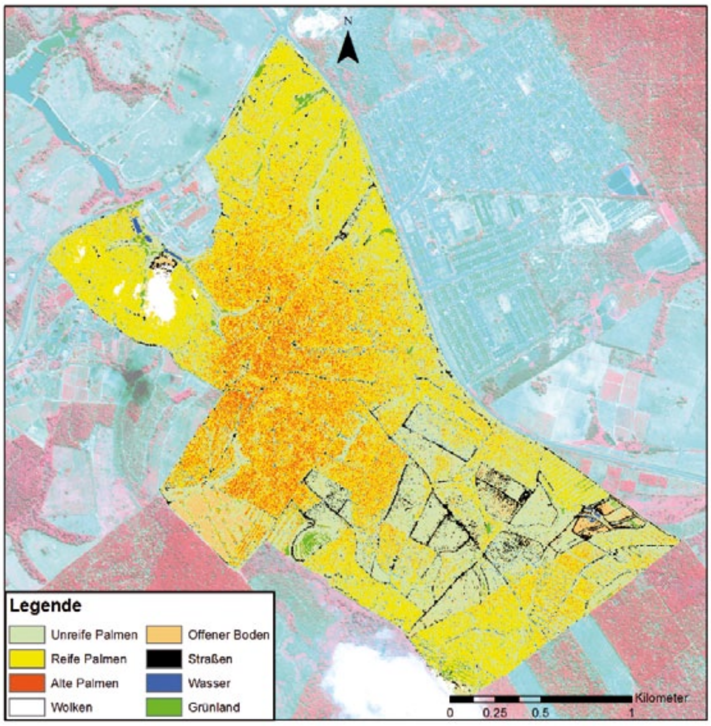


Figure 6: Classification result based on fused WV-2 imagery with light green, yellow and red as young, mature and old tree age classes for the oil palm trees, respectively *(Master project André Baldauf 2017, UOS)*

How to apply GIS and Earth Observation as a Tool for Sustainability Certification

My experience as a GEM Master student at ITC

Ditte Marie Trojaborg dmtrojaborg@gmail.com

On June 13th, I participated in the workshop in cooperation with ITC, University of Osnabrück, ISCC and GRAS where I defended my thesis "Detecting land cover change related to smallholder oil palm plantations: An automated approach based on multi-temporal Landsat imagery".

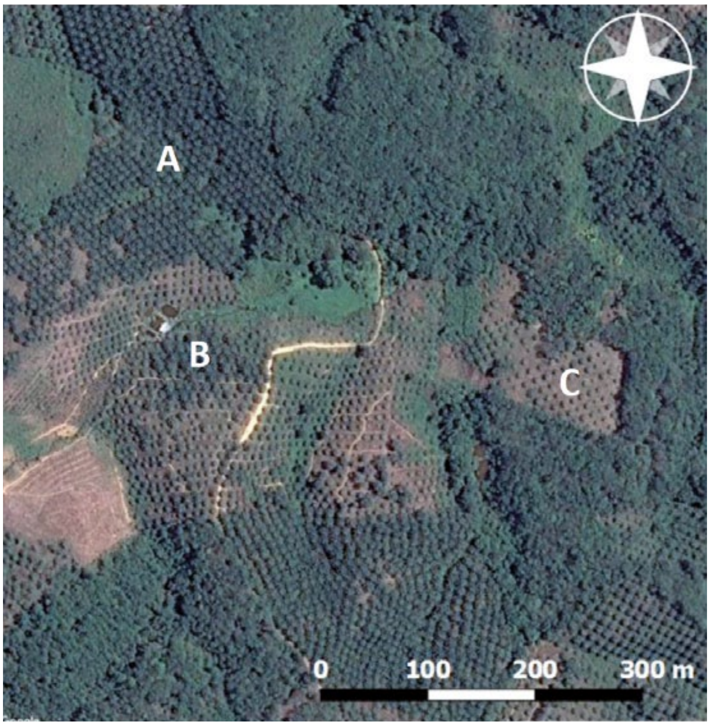
My presentation and defence went well, however, it was a bit of a personal challenge to present myself in a room full of peers and specialists in the fields of sustainability certification, the oil palm industry, remote sensing and GIS. The day continued with interesting presentations, creating a red line between all the different fields represented in the workshop, along with a creative brainstorming session. After a long day of exchanging knowledge and ideas, I was very content to have been giving the opportunity to participate with my thesis work, the result of submerging myself into the topic of using remote sensing to promote sustainability in the smallholder oil palm sector of South-East Asia for nine months.

My personal motivation for my research started during my bachelor studies in Geo-Science at the University of Copenhagen. Studying the processes of the Earth and gaining insights into how the human population exploits the planet, encouraged me to pursue geo-information science and remote sensing as tools for environmental management and sustainability. I looked towards Lund University across Øresund and found the Erasmus Mundus joint European Master of Science Course: Geo-information Science and Earth Observation for Environmental Modelling and Management (GEM). When the time came to select my thesis topic, I knew right away that working with Dr. Iris van Duren and ITC on sustainable oil palm production would fulfil my ambition of

Ditte Marie Trojaborg

developing geo-spatial methods for environmental protection through sustainable practices.

The recently joint forces between ITC, ISCC and GRAS resulted in the development of my thesis project. This cooperation gave me the opportunity to spend the first three months of my research with ISCC and GRAS in their office in Cologne. Here I could develop a deeper understanding of the world of oil palm, the production chain of bio-fuels and the concept of sustainability certification, and especially the necessity of enforcing sustainability criteria. Personally, I have always had a great interest in sustainability and the origin of consumer products, which made me really appreciate this opportunity. In regard to my research, the experience gave me context and, therefore, further motivation for the work I was doing, something I have valued greatly throughout my thesis work.



Detecting land cover change related to smallholder oil palm plantations: An automated approach based on multi-temporal Landsat imagery

Together with my supervisors in ITC, we shaped the direction of my research and the focus of my project became to map deforestation caused by oil palm plantation establishment. This was done by developing a framework for detecting the timing and location of land cover change based on Landsat time-series data. An essential part of my research was to develop a method based on open source data and software, to provide a tool that was not limited by financial constraints or advanced technical skill, e.g. related to one expensive software or data type.

While several studies have been conducted related to both mapping smallholder oil palm plantations and time-series analyses of plantations, a full framework which is useful as a tool in certification, is missing. By incorporating remote sensing into a tool for certification, a cost efficient way of enforcing sustainability criteria is achieved. For example criteria regarding location of a plantation or the date of establishment of a plantation. According to the ISCC sustainability criteria, a plantation cannot be established on land with a high carbon stock or biodiversity value, or after the cut-off date of January 2008. A tool based on remote sensing that can provide information on the time and location of plantation establishment can therefore be used to check if these criteria are met, a difficult and likely expensive challenge if it were to be done manually. An even greater challenge regarding smallholder plantations, which are often distributed in remote, inaccessible areas without proper monitoring.

In my research I developed a method using freely available Landsat imagery from 2000 – 2015 and the open source R and R Studio software environment. On a small test site in the Riau province, Indonesia, I tested two approaches, both based on using Bfast – Monitor, a near real-time change detection method, with the Landsat derived Normalized Difference Moisture Index. I found that by implementing Bfast – Monitor iteratively throughout the time-series, a relatively automated method (compared to the original Bfast) could be achieved. A final map showing annual land cover change was produced by applying the automated method per pixel.

My method development is in its early stages with my thesis work, however the timing and location of deforestation in my test area were mapped with an accuracy of approx. 90%, with open source software and medium resolution imagery. The next step will be to test the robustness of my method by conducting case studies and testing at larger scales. Hopefully the goal of developing a generic, automated method/tool for detecting deforestation caused by plantation establishment will be reached in the future. This could provide significant benefits to the process of certifying the production of palm oil. ■

> ‘For me personally, I see myself continuing to develop my skills in applying remote sensing to promoting sustainability in the agricultural sector. While being with ISCC and GRAS, I especially had the opportunity to develop my technical skills, something which has encouraged me to combine my ambitions in sustainability with data science and perhaps app development in the future’

Monitoring Vegetation Seasonality at Fine Spatial Detail

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Monitoring how vegetation cover changes in time provides an important input to assessing the sustainability of natural and agricultural ecosystems. Satellite remote sensing strongly supports the assessment of vegetation cover dynamics and can achieve a wide geographical coverage. Traditional approaches to achieve that include land cover classification and consequent change detection from multi-date classifications. Nonetheless, extraction of discrete land cover classes from single-date imagery can obscure an important part of the variability; either through classification inaccuracies or through the fact that changes may occur within a single vegetation community. Phenological analysis is an alternative approach that specifically looks at the temporal behaviour of vegetation.

Phenology and satellites

Vegetation phenology is the study of the timing of seasonal developmental stages in plant life cycles, such as the appearance of leaves, flowers and fruits. While networks using human observers and digital repeat cameras provide detailed information on vegetation phenology for specific locations, satellite imagery is the only data source that can examine phenology at the landscape scale. This can be achieved through evaluating the temporal behaviour of vegetation indices for each grid cell. Figure 1 illustrates this for a single year and grid cell, and shows how various parameters related to timing and vegetation productivity can be extracted from the temporal profile. While multiple ways exist to extract such parameters, applying a consistent approach allows for evaluating spatial and temporal patterns.

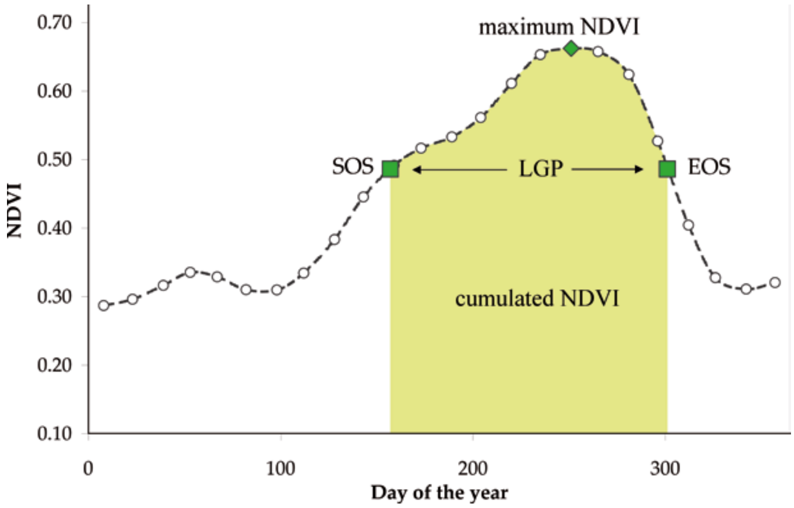

Figure 1: Example profile of the vegetation index NDVI and parameters that can be extracted from the profile including start of season (SOS), end of season (EOS), length of growing period (LGP), maximum NDVI, and cumulated NDVI. The last two parameters relate to vegetation productivity

Phenology and coarse-resolution data

Satellite-based phenological analyses require frequent cloud-free observations. For that reason most studies rely on 250 m to 8 km resolution optical imagery that is acquired at daily intervals. Long series of such data currently exist. Figure 2 shows an example of an analysis of the length of growing period from 8 km resolution data between 1981 and 2011. Besides showing spatial patterns, the time series also allows to identify temporal trends. However, the grid cells are too coarse to directly relate to behaviour of individual plants or vegetation communities. The term 'land surface

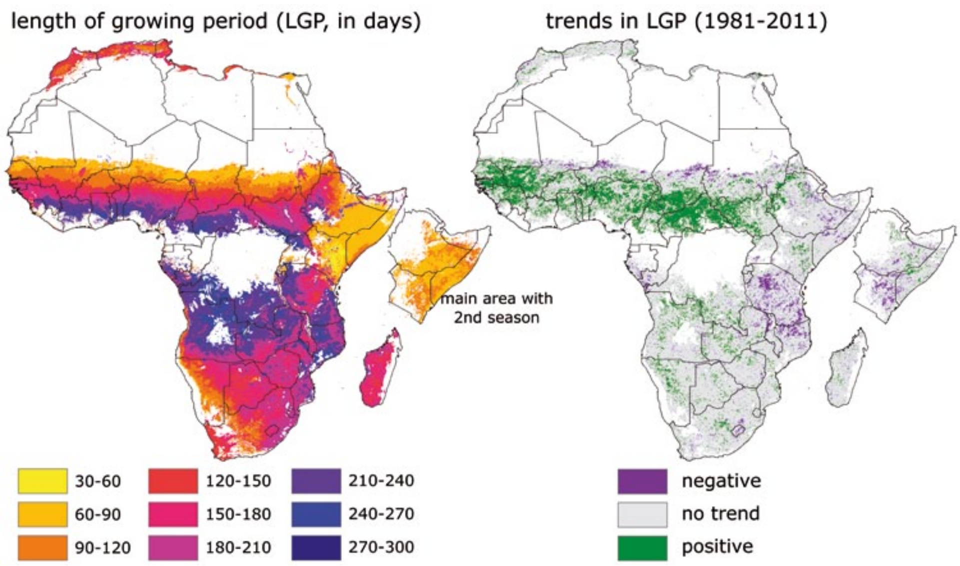

Figure 2: Average length of growing period and trends as derived from a 30-yr NDVI series (GIMMS AVHRR). Only significant trends (p<0.10) are displayed. *From: Vrieling et al., 2013. Remote Sensing, 5: 982-1000*

phenology' is therefore used to describe the aggregate temporal behaviour of the multiple plant species present within a grid cell.

Towards more spatial detail

The frequency of observations is now also increasing for satellite sensors capturing imagery at finer resolution (<30 m). For example, since March 2017 the two European Sentinel-2 satellites have acquired imagery across the globe every five days with four bands at 10m resolution. Using only the first Sentinel-2 satellite, but for a location with overlapping orbits, we have been able to demonstrate that sufficient cloud-free data can be obtained to extract phenological parameters. For the island of Schiermonnikoog (Netherlands), for each grid cell an average of 27 useful observations were available during 2016. Figure 3 illustrates this for a single grid cell and Figure 4 shows the spatial retrievals of start- and end-of-season parameters for all grid cells on the island.

Links to sustainability assessment and certification

Temporal analysis of vegetation is important for various certification schemes as well as for monitoring compliance with (inter)national regulations. Although phenological parameters may not necessarily constitute a direct input, the difference between, for example, mono-species grasslands and highly-biodiverse grasslands may be better observed when incorporating different phenological parameters. Where major land cover changes may be easily assessed with fewer satellite observations, more subtle conversions may be picked up better with more-detailed temporal information. Moreover, temporal information on vegetation seasonality provides critical input to understanding effects of climatic shifts. Satellites like Sentinel-2 can now provide such information at fine spatial detail. ■

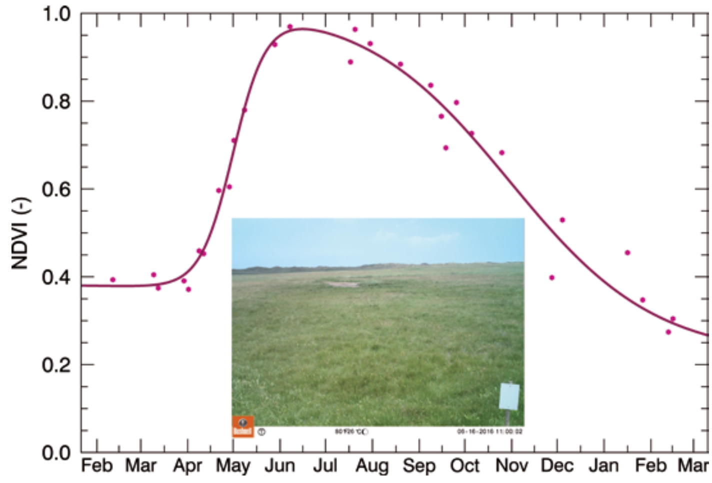

Figure 3: NDVI temporal profile derived from 10m Sentinel-2 imagery for a location on Schiermonnikoog, the Netherlands. Dots are observations, and a double hyperbolic tangent function is fitted to the observations. The inset shows a picture from the area in June 2016

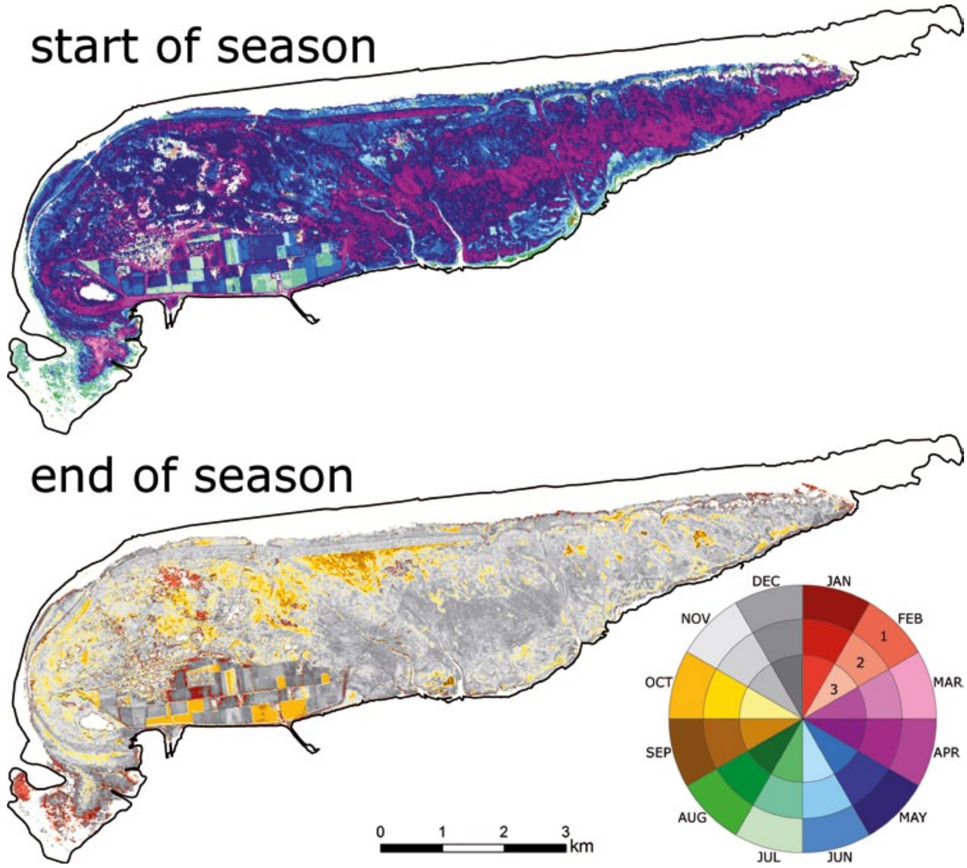

Figure 4: Estimates of start- and end-of-season derived from Sentinel-2 NDVI series for the island of Schiermonnikoog. The colours indicate the month; the outer circle represents the first 10-day period of each month

Very High Resolution Images for Biomass and Carbon Assessment

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Carbon, in the form of CO and CO^2 is one of the main elements of the Green House Gasses in the atmosphere and the continuing increase in carbon, due to exhaust from transport and industry, is a major cause of climate change. The majority of above ground carbon is sequestered in the woody biomass of trees. Forests, during their growth, are capable of sequestering carbon from the atmosphere and storing it in their stems, branches and roots. About 50% of the woody biomass is carbon. Reducing deforestation and forest degradation, enhancing forest carbon stocks and protecting existing forests have become of major importance for resource managers and policy makers. Accurately estimating the amount of carbon stored in forest ecosystems and monitoring the changes therein, is therefore of interest for the International community involved in climate change related research.

Satellite data, especially from Very High Resolution sensors such as WorldView and Geo-Eye, with a resolution of 50 cm can provide accurate information on forest biomass and related carbon stock. Thanks to the high level of detail, not only the extent of forest areas and logging gaps but even individual tree crowns can be distinguished. Research has proven that a relation exists between thickness of a tree at 1.30 cm height (called Diameter at Breast Height or DBH) and its crown area or Crown Projection Area (CPA). Through the use of so-called allometric equations, thickness of a tree is directly related to its above ground biomass. Allometric equations are empirically derived quantitative relations between the easily measurable parameters such as stem thickness and an otherwise difficult to quantify characteristic of a tree, in this case the above ground biomass. These equations provide a reasonably accurate estimate and can be even more accurate when tree height is also included.

The above implies that, when we know the crown size (as visible on the VHR image) we can estimate the stem thickness of the tree based on the relation between crown area and stem thickness. From the stem thickness we can derive its biomass by applying the allometric equation and subsequently calculate its carbon content. Using the Object Based Image Analysis approach, an image processing method which groups individual pixels together into objects based on their texture, shape, size and colour, individual tree crowns can be delineated as objects (see figure 1). These objects represent the crown area of each of those trees. Applying the relation with stem thickness and subsequently implementing the allometric equation, biomass for each crown can be calculated. About 50% of the woody above ground biomass is carbon, so this leads to the carbon content per crown as well as total carbon per hectare (see figure 2).

Although VHR images are very suitable for this approach, they are not always readily available and of good quality. A series of aerial photos taken by a simple optical camera onboard Unmanned Aerial Vehicles (UAV) can also provide good quality data with a resolution as high as 10 cm. They are relatively easy to acquire at low cost, the UAVs can already fly at an altitude of 50-70 metres, so well below the clouds and timing of data acquisition is flexible although good weather and low wind speed are a must. Obtaining flight permissions, no fly zones and overall flight organization can sometimes be a challenge.

During one flight, the UAV collects a series of small photos with a high level of front and side overlap (see figure 3). By combining hundreds of individual photos, one image of the entire flight area

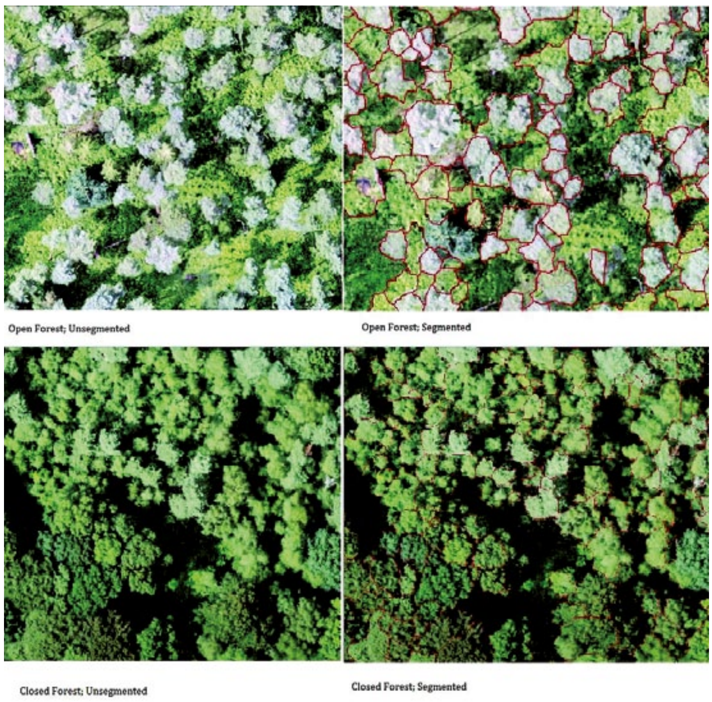

Figure 1: Tree crown delineation, red lines around the tree crowns, in open and closed forest stands. *Source: MSc thesis Jefferson Okojie, 2017*

can be generated which can be processed, similar to VHR images, and tree crown areas can be derived.

An additional benefit of UAV images is that due to the high overlap and the Structure from Motion technique, a technique comparable to stereoscopic photogrammetry, a 3D model of the trees can be constructed based on a set of 2D images. This 3D model provides information not only about the crown area but also about the height of the trees (figure 4). The accuracy of a UAV-derived tree height is comparable to that of a LiDAR derived tree height.

Woody biomass estimations can be improved if, apart from stem thickness also tree height is included in the allometric equation. Thus with an accurate crown projection area derived from UAV images, combined with the height of the trees derived from the 3D model, a more accurate estimate of above ground biomass and carbon can be made for each tree. Although the approach works well in temperate forests, accuracy declines in multi-layer tropical forests and more study is needed to increase accuracy of carbon estimation is these areas. ■

> ‘Reducing deforestation and forest degradation, enhancing forest carbon stocks and protecting existing forests have become of major importance for resource managers and policy makers’

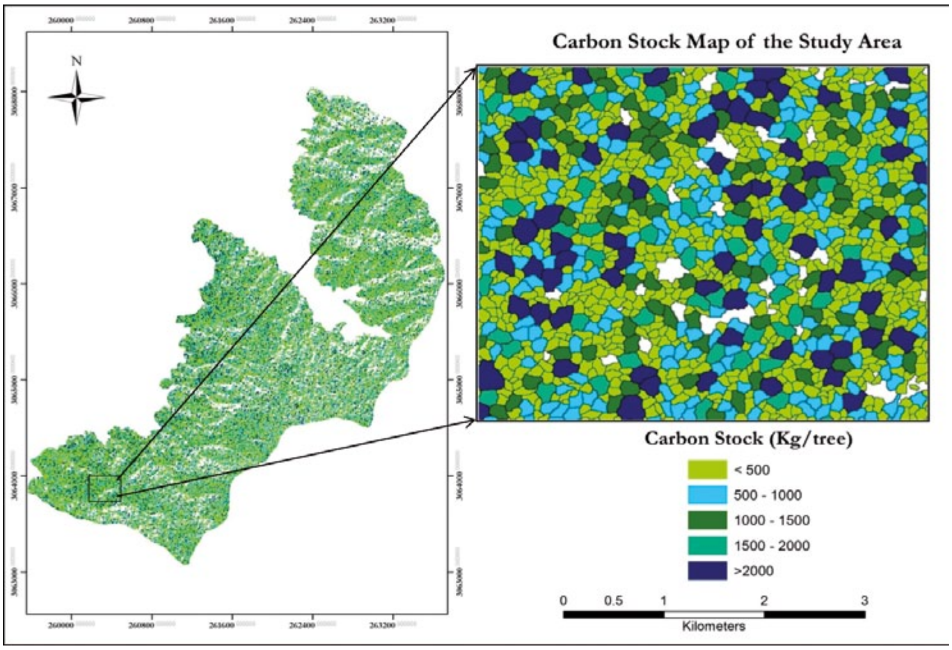

Figure 2: Carbon stock map of Chitwan district in Nepal. The inset shows the detailed of carbon stock per tree crown. *Source: MSc thesis Srijana Baral, 2011*

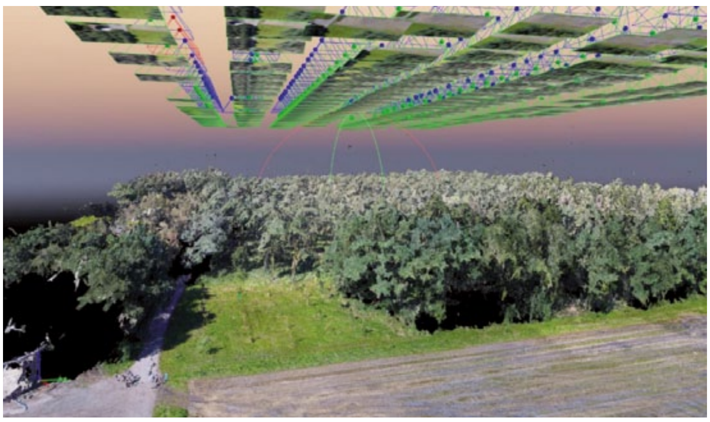

Figure 3: Section of the forest, reconstructed based on the 3D model generated from the individual UAV photos positioned above. *Source: MSc thesis Jana Erdbrügger, 2017*

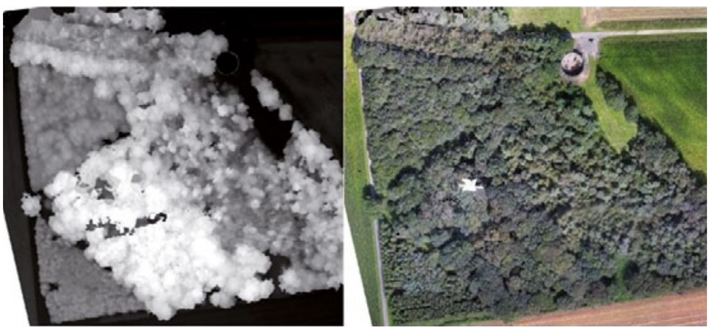

Figure 4: 3D height model and image derived from UAV data, the higher the trees in the height model the lighter the colours. *Source: MSc thesis Jana Erdbrügger, 2017*

EBVs for Monitoring Sustainability of Supply Chains

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The governments of the world together declare actions to solve key global problems and challenges. Through a treaty signed by 178 countries, the Convention on Biodiversity (CBD) develops national strategies for the conservation and sustainable use of biological diversity. But how to do this at a global scale and in a consistent and robust manner?

The Group on Earth Observation (GEO) is the key international agency charged with monitoring the Earth, and the Biodiversity Observation Network (GEOBON) specifically aims to monitor biodiversity. The essential biodiversity variables (EBVs) are designed to assess progress towards reaching the Aichi Biodiversity Targets. The Convention on Biodiversity (CBD) developed the Aichi Targets in order to monitor the change in biodiversity at national and global levels.

Though there is some scientific evidence based on local and regional studies that biodiversity is under threat globally, consistent data at a global scale is missing. Government and industry are interested in global biodiversity because of concerns whether our food production is sustainable, as farming is increasingly being enlarged to be more cost-efficient as well as more intensive. Energy supply chains from biomass – though still niche – is increasing in importance. And the Forest Sustainability Certification recognizes that timber supply must be sustainable and protect biodiversity.

All have monitoring of key indicators of sustainability in common. Sustainability can be measured through a number of metrics. The Essential Biodiversity Variables (EBVs) are a framework of metrics for measuring landscape sustainability with an emphasis on biodiversity (see figure 1). The Essential Biodiversity Variables (EBVs) are key variables that help to harmonize worldwide biodiversity monitoring by enabling consistent reporting of changes in the state of biodiversity.

Some Essential Biodiversity Variables (EBVs) can be directly measured and monitored using remote sensing. Remote sensing can play a great role, particularly in effective monitoring of rapidly changing ecosystems that cover extensive areas. In conjunction with *in situ* data, remote sensing imagery, which can be derived from airborne and space-borne sensors, provides key input to biodiversity assessment and monitoring at a fine spatial resolution and with a high temporal frequency. For example, figure 2 is a map showing the distribution of the frankincense tree (*Boswellia papyrifera)* in Ethiopia, generated during a PhD study by Atkilt Girma in cooperation with Dr. Kees de Bie and Prof. Andrew Skidmore.

Undoubtedly, the only way to effectively monitor biodiversity for sustainable supply chains at a global scale is through remote sensing. ■

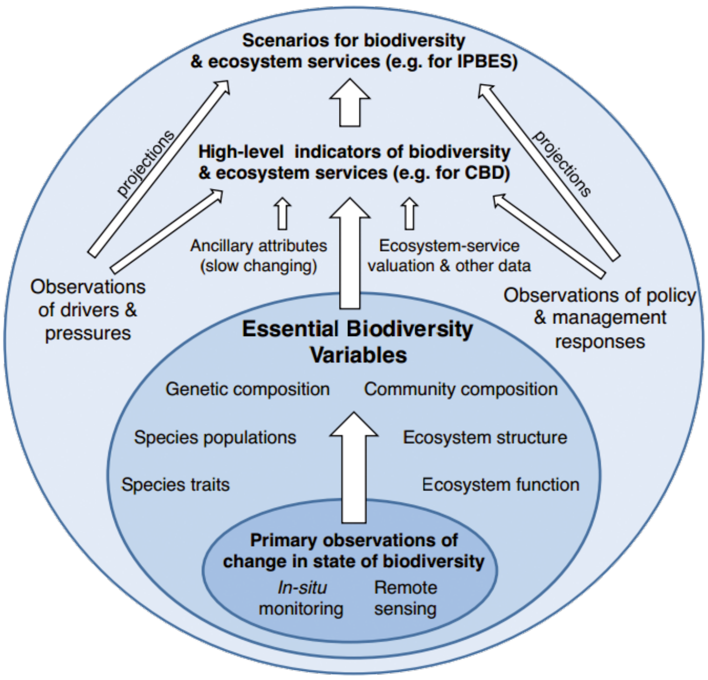

Figure 1 The Essential Biodiversity Variables (EBVs) are a framework of metrics for measuring landscape sustainability with an emphasis on biodiversity

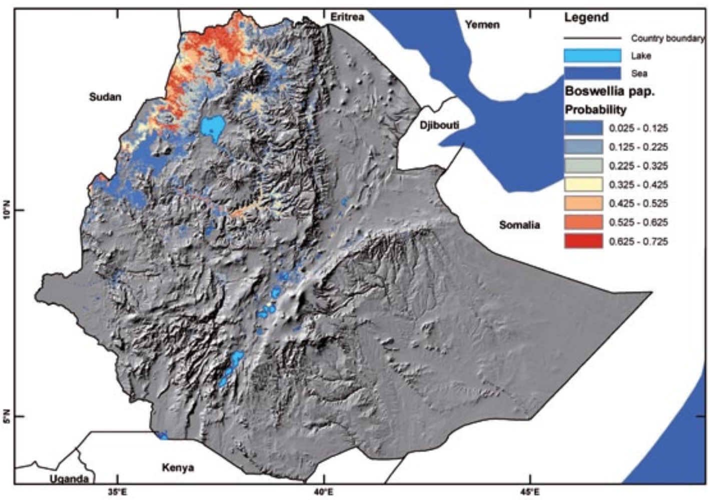

Figure 2 A map showing the distribution of the frankincense tree *(Boswellia papyrifera)* in Ethiopia.

EDUCATION NEWS

Next Generation Regional Satellites and Modelling Techniques for Integrated Water Management

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A tailor-made training course titled, "Next generation regional satellites and modelling techniques for integrated water management" was organized by the ITC department of Earth Systems Analysis together with the Thai Geo-Information and Space Technology Development Agency (GISTDA) for the Mandalay Technical University, Department of Remote Sensing (MTU-DRS). The training was funded by the Netherlands Ministry of Foreign Affairs through EP-Nuffic.

Space-based technologies have developed very rapidly over the last 10 to 15 years and many countries in SE-Asia have developed their own space technology-related capacity. Due to its isolation during this period, Myanmar has not had the opportunity to develop such capability and, as a consequence, its academic staff is not up to date with these developments. Remote Sensing is a very suitable and useful tool to support the country's development, whether it is in agriculture, forestry, water management, etc. but its deficient capacity is hindering the deployment of this tool for the national benefit. Myanmar scientists urgently need to be given the opportunity to interact with regional and international colleagues, to have (renewed) access to the latest RS-data and products, and require international support in modernizing their academic curricula.

This course consisted of two parts: The first part was a one-week training for a smaller group of six MTU staff (4 female, 2 male) at the GISTDA Sirindhorn Center for Geo-informatics, Chon Buri, Thailand (3 - 7 October 2016); the second part was a two week workshop at MTU-DRS in Mandalay, Myanmar for 20 staff (13 female, 7 male) from the department of remote sensing and other departments (8-19 May 2017).

The main focus of the first part in Thailand was on remote sensing with special reference to data received by regional satellites. It included data search, acquisition and processing of the acquired satellite data, both optical and radar data, with focus on flood extent mapping and monitoring. Also, remote sensing applications to study runoff generation in the upland areas were dis-

cussed. Emphasis was on data from Thai satellites that could be freely shared with MTU. Teaching was done by experts from ITC (Dr. Dhruba Shrestha) and by experts from GISTDA.

The 2-week training in Mandalay focused on flash flood modelling and the use of remote sensing data. In the first week hydrologic/hydraulic models were discussed, which also included a guest lecture on the application of the SWAT model for runoff estimation by Dr. Ruediger Anlauf from Osnabruck University of Applied Sciences. The second week of the training was devoted to remote sensing and field based techniques for generating data required to run the flood model, including the processing of radar data for getting soil moisture information, downloading various remote sensing products using different web links and getting global soil grid data from ISRIC. At the end of the first week, a field excursion was organized to flood prone areas along the Irrawaddy river in the outskirts of Mandalay and to the upland watershed area of a tributary river of the Irrawaddy river about 70 km east of Mandalay near Pyin Oo Lwin. The teaching was done by Prof. Victor Jetten and Dr. Dhruba Shrestha (ITC) and by Dr. Tanita Suepa and Mr. Yootthapoom Potiracha (GISTDA). Yootthapoom had just graduated for his MSc from ITC a few weeks earlier!

This two-part training has been very intensive and has resulted in a good partnership between ITC, MTU and GISTDA. The training has provided MTU staff with up-to-date knowledge on recent developments in (regional) satellites and RS-data, and its application for watershed management with emphasis on flash-flood generation. All training materials have been shared with the staff so they can use it for their own training and teaching activities. On top of that, GISTDA has offered to provide data to MTU for academic usage and has also offered two scholarships for staff for additional training in Thailand. For all it has been a very rewarding experience and we hope that it will be the start of a long collaboration. ■

ANNOUNCEMENTS

Wilbur Ottichilo Elected Governor Vihiga County

Communication Department news-magazine@utwente.nl

We are very delighted to learn that ITC alumnus Dr. Wilber Ottichilo won the race for Governor of Vihiga County. On behalf of the ITC community we would like to take this opportunity to congratulate Wilbur Ottichilo on this well-deserved and overlong success.

Study at ITC

Having obtained his bachelor's degree in Biology, the 29-year-old Wilber Ottichilo arrived at ITC for the first time in 1981 to participate in a series of courses. "It really opened my eyes. I came as a village boy and left as a global citizen. It was my first time in Europe; I had never seen snow; I mixed with people from all over the world. Until then, I had never met any American or Chinese people. When we talked, I noticed we all had similar stories. They faced the same challenges and we all learned from one another's experiences. Problems that seemed unsolvable suddenly became challenges that we were able to deal with."

In 1997, Ottichilo returned to ITC, obtaining a PhD in Use of Geo-information in Natural Resources and Environmental Assessment in 2000.

Career

Ottichilo's first real job was in 1974, when he became a physics teacher at a secondary school in Maseno. He worked as a researcher and manager in various ministries, and accepted a job as director general of the Regional Centre for Mapping of Resources for development (RCMRD) in 2000.

In 2008, he was elected Member of Parliament for the Emuhaya constituency, in the south-west of Kenya. In 2013, he was re-elected. In 2015, Wilber has been ranked as the elected Member of Parliament with the highest approval rating from his constituents, according to a survey by Kenya-based Infotrak Research & Consulting. ■

Hon.Dr. Wilber Ottichilo

Smart Urban Mobility Lab in Curitiba Open for Business

Communication Department news-magazine@utwente.nl

Last August, Theo Toonen, Dean of the Faculty of Behavioural, Management and Social Sciences (BMS) at the University of Twente, opened the Smart Urban Mobility Lab (SUM-LAB) in the Brazilian city of Curitiba. He was also acting on behalf of the university's Faculty of Engineering Technology (ET) and Faculty of Geo-Information Science and Earth Observation (ITC).

The research facility in this Brazilian metropolis (which is located near São Paulo) is an initiative of the city of Curitiba, two local universities – the Pontifical Catholic University of Paraná (PUCPR), the Federal University of Technology - Paraná (UTFPR) – and the University of Twente.

Challenges in urban mobility

Researchers from each of the partners will work together in the SUM-LAB to formulate the key challenges facing urban mobility in the metropolis of Curitiba. They will also examine ways in which these challenges can best be met. These researchers will cooperate in the context of various studies and in testing innovative mobility solutions, using the city as a Living Lab. The lab is located at the UTFPR.

Maya van den Berg from het Institute for Innovation and Governance Studies (BMS), Prof. Karst Geurs of the Centre for Transport Studies (ET) and Dr. Anna Grigolon from Urban Planning (ITC) are the initiators from the collaboration. The first steps were taken in 2015, when the University of Twente concluded an agreement with 14 Dutch and Brazilian partners to transform Curitiba into a smarter, more sustainable city.
Since then, researchers and students – representing a range of academic disciplines at the universities involved – have been cooperating in the area of urban development and mobility. In the long run, the researchers want to widen their focus to include other urban projects, such as energy and water.

Curitiba

Curitiba, which is in southern Brazil, is a city with a population of about two million. In Brazil, this city is a pioneer in innovative public transport. It ranks among the leaders in an innovative approach to urban development. Thirty years ago, the city launched a Bus Rapid Transit (BRT) system, offering a high frequency service (every 90 seconds, in some cases) with comfortable and attractive buses. This has resulted in a system that combines high usage with relatively low costs.

However, the BRT system has now reached its maximum capacity, and car use in the city has increased significantly. Making transport even more sustainable is now a high-priority item on the agenda. More innovative and environmental friendly urban mobility is high on the political agenda and the researchers in the SUM-Lab will collaborate in further realizing this together with the city of Curitiba. ■

A festive opening of the Smart Urban Mobility Lab (SUM-LAB) in the Brazilian city of Curitiba

Thirty years ago, Curitiba launched a Bus Rapid Transit (BRT) system, offering a high frequency service (every 90 seconds, in some cases) with comfortable and attractive buses

National Student Survey 2017: Increased Satisfaction on Master Geo-information Science and Earth Observation

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ITC takes part in the annual National Student Survey. It is a survey amongst students in which they are asked to rate their study experience on various themes. Though it is interesting to see how the faculty scores compared to its counterparts, it is mainly a very helpful instrument in increasing the quality of education and facilities.

This year's results show a significant increase for appreciation of the Master Geo-information Science and Earth Observation, in comparison with both last year and similar educational programmes at other universities.

ITC students at work *(Photo by Rikkert Harink)*

Comparison nationwide

Compared to similar educational programmes in the Netherlands, the ITC Master on Geo-information Science and Earth Observation scores above average on almost all themes. For instance, there are (much) higher scores on study facilities, quality care, content, academic guidance and study information.

The highest theme scores are on study facilities (4.40), content (4.36), lecturers (4.35) and programme schedules (4.34). Study load (3.88) and career preparation (3.99) are themes which need attention. The only score that is (slightly) lower than the reference group average is the one on career preparation. Students seem to prefer more emphasis on linking their education at ITC to their career paths.

Improvement

Compared to the scores in 2016, satisfaction with the study programme in general increased from 4.08 to 4.32. The general atmosphere in the study programme scored 4.14 in 2016 and increased to 4.35 in 2017 and the score on whether the programme would be recommended to friends or family increased from 4.16 to 4.40.

Fourteen out of fifteen theme scores show an increase. No themes show a decrease and the score on general skills is equal to 2016. Academic guidance/counselling (+0.37: from 3.92 to 4.29) and testing and assessment (+0.35: from 3.92 to 4.29) show the highest increase. The extra attention for quality care in the past year seems to have paid off, with an increase of 0.31 (from 3.94 to 4.25).

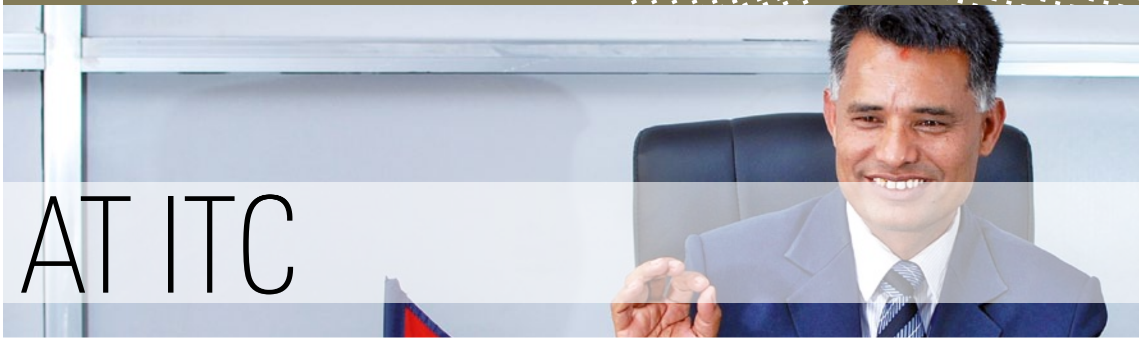
Open Questions

In the answers to the open questions, the most striking ones were the remarks regarding the study load and the wish for a 2-year programme. In addition, remarks were made regarding the wish for internships; the integration with EU students and the move to the campus; and the wish for more learning rather than retention. These remarks are consistent with earlier feedback from students and have played an important role in the decision on the transition to a 2-year programme in 2018. The remarks will be taken into account in the development of this 2-year programme and the desired move to the campus.

Follow-up

The Faculty ITC is very satisfied with the results of this survey and, therefore, thanks the students for participating and staff for contributing to these results. The results of this survey will again be used in ITC's internal quality care system and further development of education and education support. The challenge is to make sure that the scores remain this high in the upcoming years and even though the results are very positive, there is always room for improvement. ■

VISIT AT ITC



Happy to be Back in ITC – my Second Home

Dimo Todorovski
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On Friday 30 June 2017 ITC alumnus and the Director General of the Survey Department at the Ministry of Land Reform and Management in Nepal Mr. Ganesh Prasad Bhatta visited ITC for some preliminary discussions for possible future cooperation with ITC and his organization from Nepal.

Ganesh was part of 12 member high level delegation from the Government of Nepal, visiting the Netherlands Kadaster in the period of 26-29 June 2017. Being present in the Netherlands he extended his stay with a specific purpose to visit ITC.

During the short stay at ITC several meetings were organized. At the first meeting, ITC Dean/Rector Tom Veldkamp congratulated Ganesh with his new position and Ganesh presented "The Population and Socio-Economic Atlas of Nepal" to the Dean/Rector Tom Veldkamp. In addition, Ganesh visited Land Administration Specialization group of Faculty ITC and had meeting with available colleagues exchanging ideas about possible future cooperation in the areas of Land Administration capacity development and education.

Ganesh dedicated some time to meet and discuss the current Nepalese ITC staff, PhD candidates and MSc students in the well-known ITC Restaurant. During the meetings Ganesh stated that he is "happy to be back in ITC – his second home" ■

Rector/Dean Tom Veldkamp receiving a gift from Mr Ganesh Prasad Bhatta

Mr Ganesh Prasad Bhatta and Dr Dimo Todorovski

Nepalese meeting in the ITC Restaurant

Greetings from…

NAME:

Yunmeng (Emily) Zhu

JOB DESCRIPTION:

ESRI Intern working in the 3D Scene Layers team, focusing on designing solutions and implementing scene layers for the ArcGIS platform

ACTIVITIES:

I am analyzing how the space time cube shows both time and space datasets in ArcGIS Pro, and extracting multidimensional information from netCDF and transferring them to bin and json files using python.

Project and Training courses

I'm working in the 3D Scene Layers team, focusing on designing solutions and implementing scene layers for the ArcGIS platform. I prepared test data for 3D geospatial fields, ranging from subsurface soil type to ocean temperature, city criminal hot spots and cold spots. A project we are focusing on is volumetric Visualization. I'm responsible for analyzing how the space time cube shows both time and space datasets in ArcGIS Pro, and extracting multidimensional information from netCDF and transferring them to bin and json files using python.

During the project, I took some fantastic online training courses like "Introduction to Groprocessing Scripts Using Python", "Distributing data Using Geodatabase Replication", "Developing Web Apps with ArcGIS API for JavaScript", etc. They are so interesting and useful I can apply what I have learned in my work immediately.

Esri activity

Attending Esri User Conference is the most amazing thing I did during the internship. San Diego is perfect and I stayed there for the whole week. I attended the pre-conference session, several technical sessions, and workshops.
It is a good platform for displaying the most cutting-edge skills in the GIS field. The Expo booths were terrific too! Many GIS or GIS-related companies came to the Esri User Conference showing their collaboration with Esri, exchanging ideas and searching for solutions.

The Monday night Map Gallery was amazing and so was the Thursday night party with different styles of music, exotic food and old fashioned museums – all in one park!

Living in Redlands

Staying in the Redlands, I got a good chance to visit the most popular places in California, such as Los Angeles, Las Vegas, San Francisco, and Santa Monica beach. Luckily, I found a tennis club at the University of Redlands. I had fun and was really glad I joined. The A.K. Smiley public library is cool too.

Conclusions

I'm grateful for ITC and Esri providing such an invaluable internship. I contribute my knowledge and energy to Esri. At the same time, my technical skills and problem-solving ability improved a lot and I learned a lot from the team about reporting project progress and how to co-work with team members. After a few months' working at Esri, I have come to the realization that GIS is really a great science and a glorious one too as it can save people's lives from disasters and make people's lives more efficient. I'm proud to be working at Esri!

LIFE AFTER

ITC Alumni Party at the International Cartographic Conference

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Every two years cartographers from all around the world meet at the International Cartographic Conference. This year they gathered in Washington DC (USA), from 1 - 7 July. This means that it took place in the week the USA celebrate Independence Day, so conference participants were able to take part in the traditional picnic on the lawn of the Capitol and watch the music and fireworks!

A recurring tradition at these conferences is an ITC alumni meeting, and this year it was organized in the late afternoon of 6 July. All former and current students, staff and co-operators of ITC present at the conference were cordially invited to gather at Harry's Pub, in the conference hotel lobby. Some 25 alumni answered the call, and this resulted in a lively informal meeting, were the attendants enjoyed a few drinks and snacks, while acquaintances were renewed. Menno-Jan Kraak welcomed the alumni in his capacity as ITC professor, taking a break from his duties as the current ICA president. A good time was had by all, and the intention is to certainly continue the tradition in two years' time at the 2019 ICC in Tokyo (Japan). ■

ISPRS Grant for ITC Alumnus Fredrick Arthur Onyango

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One month after his graduation at ITC, Fredrick Arthur Onyango submitted a paper entitled Accurate Estimation of Orientation Parameters of UAV Images through Image Registration with Aerial Oblique Imagery to the ISPRS Hannover workshop.

The paper was based on Fredrick's MSc thesis Multi-resolution Automated Image Registrations", co-authored by F. Nex, M.S. Peter and P. Jende. It was accepted as poster presentation and Frederick received a travel and accommodation grant from the ISPRS Foundation. He was entitled to attend the conference and receive the money for his travel and accommodation. ISPRS president Professor Christian Heipke handed over the grant to Fredrick during the presentation of his poster at the ISPRS Hannover workshop.

The ITC community congratulates Fredrick with this achievement! ■

Frederick Arthur Onyango graduated in March 2017 with a MSc degree if Geo-Information Science and Earth Observation, Specialization: Geoinformatics.

Please find his full MSc Thesis here: www.itc.nl/library/papers_2017/msc/gfm/onyango.pdf

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