The High Carbon Stock Science Study:
Independent Report from the Technical Committee

December 2015
This report has been independently prepared by the authors below, who comprised the Technical Committee of the High Carbon Stock Science Study. The report is supported by a wide range of consulting studies in the areas of soil carbon dynamics, biomass estimation, remote sensing, and socio-economics. The full reports of these studies are in Appendix 5. This report covers all the work on the High Carbon Stock Science Study conducted by the Technical Committee, and comprises the following three components:

Part 1: Extended Summary
Part 2: Synthesis Report
Part 3: Gabon Case Study

Part 1 and Part 2
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- The consultants who have provided valuable support for our work. The reports from this activity are provided in Appendix 5;

- Olam Palm Gabon for generous collaboration on a case study covering the field evaluation of several parts of the HCS+ methodology in their oil palm developments in Gabon. Christopher Stewart and Audrey Lee led Olam’s contributions to the case study, which forms Part 3 of this report;

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**Part 3: Gabon Case Study**  
The HCS+ methodology tested on the ground  

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This study proposes a new pathway, HCS+, to solving the potential problems arising from the conversion of tropical forests to oil palm plantations.

There is wide agreement that High Carbon Stock (HCS) forests should be protected. These forests store large amounts of carbon that are released by conversion - accelerating climate change. Just as important, these forests provide livelihoods for local people. They are also home to a wide variety of animal and plant species - many of them endangered - and provide invaluable ecosystem services to humanity.

Existing policies to protect HCS forests (often summed up under the label ‘No Deforestation’) have laudable aims. But they are proving very difficult to put into action in the real world. Part of the problem is lack of agreement on how to define forests and deforestation (Box 1).

The principal reason for the difficulty in implementing ‘No Deforestation’ commitments is that the governments responsible for alleviating poverty in rural areas see conversion of tropical forests as a pathway to development. Many involved in the governments of Malaysia and Indonesia, for example, see the ‘No Deforestation’ approach as the equivalent, in practice, of ‘no development’.

The HCS+ methodology offers the possibility of delivering palm oil development that:

- Ensures carbon neutrality and contributes to protecting essential non-carbon forest values;

- Protects human rights and improves welfare;

- Is economically viable, and acceptable to key stakeholders including governments, local communities and companies undertaking new developments.

HCS+ makes it possible to achieve these goals while also allowing the carefully planned conversion of some limited areas of forest to oil palm. This suggestion may – initially at least – alarm those who believe that only a strict ‘no deforestation’ position can properly protect valuable forests.

We ask them to read our science-based report in full, and to consider carefully the potential benefits of the proposed new pathway. We believe there is much scope for finding convergence between the existing HCS Approach1 and the HCS+ methodology outlined in this report.

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1 The HCS Approach is the name used for a multi-stakeholder initiative set up to promote the use of a ‘no deforestation’ methodology first developed by Greenpeace, The Forest Trust and Golden Agri Resources (GAR) in 2012. This methodology permits the clearing of small patches of forest as part of a more integrated land use approach.

2 The Sustainable Palm Oil Manifesto is an initiative of five major oil palm growers (Asian Agri, IOI Corporation Berhad, Kuala Lumpur Kepong Berhad, Musim Mas Group, and Sime Darby Plantation), together with Cargill, Unilever and Apical Group.

3 Full details of the High Carbon Stock Science Study and its governance arrangements can be found at www.carbonstockstudy.com.

4 The Technical Committee (TC) carried out its work independently. The Steering Committee (SC) was regularly informed of emerging conclusions throughout the study. The SC provided comments on drafts of this report. Final decisions on the contents of the report rest with the TC. Thus the SC had no role in approving the final report and endorses the independent role of the TC.
Box 1: Forests and deforestation

In this document we use the terms ‘forest’ and ‘deforestation’ with a colloquial meaning, avoiding strict definitions. These terms are used very differently by various global and regional organisations. Some use poorly-defined terms such as ‘viable forest’, which can mean either existing regenerating vegetation, or its capacity to evolve into forest with important values. Some do not see deforestation as absolute, so that ‘No Deforestation’ can allow the clearing of forest patches with lower long-term viability. Then there is the term ‘zero net deforestation’, where clearing of natural forests can be off-set by new forest planting.

According to the United Nations Framework Convention on Climate Change (UNFCCC) ‘forest’ may have a very low carbon stock as the definition includes: ‘young natural stands and all plantations which have yet to reach a crown density of 10-30 per cent or tree height of 2-5 metres’; Forests are also highly dynamic and as they grow, their characteristics and the values they contain evolve. The UNFCCC recognises this by including in their definition of forest: ‘areas normally forming part of the forest area which are temporarily un-stocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest’.\(^5\)

Conversion of old growth forest to oil palm plantation would in UNFCCC terms not be seen as deforestation, because an oil palm plantation also complies with the UNFCCC’s definition of forest. Net deforestation in the context of the UNFCCC is not a useful concept to address greenhouse gas balances when other values (especially biodiversity) in natural compared to plantation forests have to be taken into account.\(^6\)

On the other hand, the UN Food and Agriculture Organization (FAO) definition of ‘forest’\(^7,8\) excludes stands of trees established primarily for agricultural production and considers oil palm stands as ‘non-forest plantations’ or ‘other land with tree cover’. The FAO, however, does include rubber plantations under ‘plantation forests’, which makes the conversion of a rubber plantation to an oil palm plantation ‘deforestation’ in FAO terms.

The highly variable definition of forest and deforestation causes confusion and does not help address the key issue at stake in this study: the estimation of forest carbon stocks, carbon stock losses and emissions from land use change and subsequent land management. We define HCS forests in terms of their carbon stock as well as the other important values that they contribute.

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\(^1\) UNFCC 16/CMP.1

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Part 1: Extended Summary

HCS+: A new pathway to sustainable oil palm development
Section 1: The Conceptual Basis for HCS+ Methodology

One of the major questions facing us all is this: how can we reduce and eventually eliminate tropical deforestation, while also addressing the need to end chronic poverty and respond to a growing demand for vegetable oils that has led some countries to turn to crops such as oil palm, through the conversion of forested areas? We believe the HCS+ methodology outlined in this report takes us a significant step closer to resolving this question.

Over the next decades, tropical forest land will come under increased pressure from the expansion of oil palm and other crops. There has been strong growth in the oil palm sector during the last decade and this is expected to continue. Improvements in productivity, especially by smallholders, will go some way to meet this new demand. But there will inevitably be pressure for new planting, even if some of this can be met by planting on already degraded land.

It is vital that any land conversion is done sustainably — that is, that it produces genuine economic and social benefits while avoiding unacceptable environmental damage. Done well, the conversion to oil palm of tropical forests with low-carbon stock can contribute significantly to sustainable development. Done poorly, it leads to adverse social outcomes such as loss of rights and livelihoods. It can also cause loss of biodiversity, damage to soil and water, and large emissions of greenhouse gases.

This Study builds on other work aimed at improving the sustainability of palm oil production, primarily through the Roundtable on Sustainable Palm Oil (RSPO). This voluntarily implemented certification process includes High Conservation Value (HCV) assessments; ensuring the Free, Prior and Informed Consent (FPIC) of local communities; and other social and environmental impact assessments.

Our Study concentrates on concession level processes, but within the context of the larger landscape, and has a geographical focus on Southeast Asia and West and Central Africa.

The HCS+ methodology provides criteria to identify forests and soils that should not be converted to oil palm — thereby safeguarding ecosystem services. Areas that do not match these criteria can be converted. However, HCS+ proposes that, at the concession level, carbon losses from conversion should be balanced by carbon gains, to achieve carbon neutrality across the concession as a whole.

The HCS+ methodology places a strong emphasis on constraining carbon emissions within a framework that protects important forests but also supports sustainable development, including through the conversion of some forests to oil palm plantations. The ‘HCS’ in the name relates to the focus on carbon emissions. The ‘+’ indicates opportunities for improved livelihoods by allowing some level of responsible conversion of forests to oil palm plantations.

HCS+ provides a process for the integration of HCS considerations with HCV, FPIC and other important inputs to support the sustainable development of new oil palm plantations. Integration is achieved using a comprehensive multi-stakeholder process to determine the acceptable location and magnitude of future land conversion to oil palm (Figure 5). In the HCS+ methodology, reliable estimates of carbon stocks are critical, because these are used both to define High Carbon Stock forests and to underpin planning for carbon neutral development.

HCS+ sets out three requirements or ‘Pillars’ needed for oil palm development to be considered sustainable. These three Pillars must be constructed independently, without trade-offs between them:

**Pillar 1: Land conversion for oil palm plantations must maintain critical ecosystem services.**

Tropical forests provide multiple ecosystem services. At the global scale, tropical forests and soils help regulate climate. When land is converted to oil palm plantations, carbon stored in biomass and in soils is released to the atmosphere as a greenhouse gas. Tropical forests also harbour more biodiversity than any other terrestrial ecosystem. At the local scale, tropical forests produce many other benefits. These benefits include protection of watersheds from erosion, and support for plants and animals that provide food security and livelihoods for local communities.

**Pillar 2: Oil palm development must ensure socio-economic benefits for local communities.**

Carefully planned and executed oil palm development can benefit local communities by providing access to employment and services. It can also contribute to economic development at the regional and national scale. Conversely, inappropriately planned and executed oil palm development can violate human rights by displacing local people without compensation or consent, and by creating food insecurity in local communities as a result of severing access to traditional food sources. The HCS+ methodology allows Pillars 1 and 2 to be achieved simultaneously — and without net carbon emissions — through carefully planned and executed oil palm development.

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Pillar 3: Oil palm development must be economically viable.

The economic viability of oil palm concessions is highly dependent on maintaining low production costs and obtaining high yields. Only if both are achieved can reasonable revenues and profits be produced. Therefore the HCS+ methodology proposed for Pillars 1 and 2 must be practical and cost-effective. It must, for example, take account of the increased production costs (resulting from, for example, additional management or lower yields) that may result from prioritising land conversion in locations with poor soils, or on degraded land, or in areas with seasonally dry climates.

Adherence to the HCS+ methodology has the potential to produce many economic benefits for palm oil producers:

- Access to markets that demand more stringent practices for the production of sustainable palm oil;
- A stable workforce for supporting services such as land clearing, construction work, planting, logistic support and the management of plantations and forest set-asides;
- Improved relations with local communities, which can reduce conflicts over land and facilitate operations.

Specifically, HCS+ provides:

- Carbon thresholds to define High Carbon Stock forests and High Carbon Stock soils. These lands should not be converted because they contain not only High Carbon Stocks but also other important forest values that may not be covered by the covered by HCV assessments\(^2\), which focuses only on HCVs of ‘outstanding’ value.
- Guidance on how to make reliable estimates of carbon emissions from land conversion, and how to achieve carbon neutral development.
- Guidance on how to enhance the protection of human rights and how to ensure positive socio-economic benefits.

All this, together with other inputs, can be integrated through the participation of multiple stakeholders to produce robust land-use and land management plans.

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\(^2\) A high conservation value area (HCPA) is an area that contains one or more High Conservation Values (HCVs). HCVs are biological, ecological, social or cultural values considered outstandingly significant or critically important, at the national, regional or global level. A HCV assessment is a process to identify, manage and monitor HCVs.
Section 2: The Role of Mapping and Remote Sensing in HCS+ Methodology

The HCS+ methodology uses remote sensing for three purposes:

- Mapping above-ground carbon using airborne LiDAR\(^3\) (supported by forest inventory);
- Mapping vegetation and land use in a concession and adjacent areas using high resolution optical satellite data; and
- Mapping peatlands and other organic soils using remote sensing data.

2.1 Mapping above-ground carbon

To identify High Carbon Stock forests, we recommend a combination of airborne LiDAR and forest inventory (where data is gathered on the ground).

Airborne LiDAR is used to make high-resolution, continuous maps of above-ground carbon. This methodology is robust and non-controversial and allows reliable identification of the size and location and carbon content of forest ‘patches’ - small forest fragments - a critical issue for the delineation of HCS forests and the design of new oil palm plantations.

Accurate carbon-mapping using LiDAR can only be achieved if the LiDAR output is carefully calibrated using on-the-ground forest inventory data with respect to tree heights, trunk diameters and wood density. Using LiDAR alongside selected forest inventory plots is the most cost-effective way to produce detailed spatial information on above-ground carbon with the accuracy necessary to identify High Carbon Stock forests (Figure 2).

At the concession scale (5,000−100,000 ha), full area LiDAR coverage costs US$5−15 per hectare depending on the remoteness, size, accessibility and complexity of the area. The per hectare costs drop with the size of the area. The costs would be borne by the concession holders. For supported smallholders, the costs should be integrated into existing support schemes. For independent smallholders, new financial support schemes would have to be developed - for example, through HCS+ smallholder co-operatives or through existing certification schemes such as RSPO.

2.2 Mapping vegetation and land use in the concession and adjacent areas using high-resolution optical satellite data

Information about the land surrounding a planned concession provides important context to guide decisions within the concession boundary. There are various types of remote sensing technology that could be used to map the areas adjacent to the concession. Best cost-effectiveness is currently reached by using high resolution sensors such as RapidEye or new SPOT, in combination with medium resolution data from Landsat or Sentinel, supplemented with GIS data. RapidEye data costs between US$1-2 per square kilometre. Landsat data is free.

2.3 Mapping peatlands and other organic soils

Tropical peatlands are difficult to access, making field mapping problematic. However, remote sensing, in combination with available map information and targeted ground sampling, gives a good balance between comprehensiveness and accuracy. Remote sensing and existing data allow a preliminary detection of major tracts of peatlands/organic soils. These findings must then be validated through ground sampling. Both steps require the involvement of experienced landscape and peatland ecologists.

Where climate is concerned, there is no threshold above which emissions become relevant, and below which they are no longer relevant. All emissions, big and small, contribute to the build-up of greenhouse gases in the atmosphere. The determination of a carbon threshold can therefore not be based only on climate considerations, but must build on general and widely accepted notions of what constitutes ‘a significant forest’. This includes not just its carbon stock, but also its ecosystem services and biodiversity.

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\(^3\) LiDAR: Light Detection and Ranging - remote sensing technology measuring distance by illuminating the target with a laser and analysing the reflected light.
Section 3: HCS+ Methodology for Estimating Carbon Stocks and Achieving Carbon Neutral Development

3.1 Forests and carbon

Carbon in forests is stored in biomass and in soil. The amounts of carbon can be large, but can rapidly decrease following disturbance from deforestation, logging, fire, or drainage of organic soils. The loss of forest carbon stocks contributes to carbon emissions (mainly as carbon dioxide, CO$_2$) which in turn contributes to climate change.

*Biomass carbon*

Forest biomass is made up of living and dead trees. This biomass stores a large amount of carbon - 50% of its dry weight is carbon, and forest biomass can store up to several hundred tonnes of carbon per hectare. Forest biomass has two components - above-ground and below-ground. The larger component (about 75%) is above ground - tree trunks, branches, leaves. The rest is below ground - coarse and fine roots (about 25%). Woody debris (mainly dead and fallen trees and branches, as well as the remnants of logging) can make up a significant amount of the biomass. As forests grow, both above-ground and below-ground biomass increases. When forests are cleared the biomass oxidises and the carbon it contains is released to the atmosphere as carbon dioxide.
Part 1: Extended Summary
HCS+: A new pathway to sustainable oil palm development

Soil carbon

Carbon in soil is the other principal stock of carbon in forests. Soils vary greatly in their carbon stocks. A hectare of sandy mineral soil can contain less than 100 tonnes of carbon, while the same area of deep peat can contain many thousands of tonnes of carbon. Conversion to oil palm on carbon-poor soil will produce relatively low emissions. Carbon losses from mineral soils\(^4\) take place slowly after conversion - unless the conversion involves substantial earthworks and movement of soil. But draining peat and other organic soils can produce large losses of carbon - annual emissions of between 10 and 20 tonnes of carbon per hectare can result. Peat fires can also cause significant losses of carbon in a very short time, as well as contributing to major environmental and health impacts via the production of haze.

Calculating net carbon losses and gains

When calculating the net loss of carbon caused by converting forest to oil palm planting, the relevant baseline for comparison is what would have happened to the land without conversion. Thus, it is not just carbon losses from the existing biomass that have to be taken into account. The future carbon sequestration that is foregone by removing the forest also has to be accounted for, or alternatively the future carbon losses that would result from uncontrolled degradation if the forest were not converted to oil palm. That said, conversion can itself bring compensating gains as the newly developing oil palms themselves sequester carbon. When cleared land or grassland is converted, the gain in carbon stock in the oil palm biomass over the 25-year crop cycle may exceed the losses of carbon from the converted land.

3.2 Defining carbon thresholds

Carbon thresholds are central to the HCS+ methodology. These thresholds are set according to the amount (tonnes) of carbon estimated to exist per hectare of land. The thresholds are used to identify land and forest that must be protected and land and forest that can be converted. The HCS+ methodology uses two thresholds, one for above-ground carbon, and the other for soil carbon. We have set both thresholds at the same level: 75 tonnes of carbon per hectare.

Above-ground carbon threshold

To define the above-ground carbon threshold, as our main metric used is above-ground biomass carbon. This metric does not include deadwood carbon on the forest floor and therefore does not represent the total above-ground carbon stock. We use biomass carbon because of the difficulty of assessing levels of deadwood carbon using remote sensing. In any case, including deadwood carbon in the accounting of above-ground carbon would only make a significant difference in logged forests, and these tend to be above our threshold of 75 tonnes of above-ground carbon per hectare. We have set this threshold guided by a global overview\(^5\) and we use the above-ground carbon threshold to define High Carbon Stock (HCS) forests. These include the largest natural above-ground stores of carbon globally: old-growth forests; managed forests still growing after selective logging; and secondary forests more than 30 years old. Any deforestation of HCS forests will contribute substantially to global greenhouse gas emissions. These forests should not be converted to oil palm.

Soil carbon threshold

In addition to above-ground carbon, soil carbon also has to be taken into account. This applies particularly to peaty (highly organic) soils. Peatlands are the most significant carbon stores we have. Although they cover only 3% of the land area, they contain more carbon in their peat soils than the entire forest biomass of the world. A tropical peatland, for example, contains on average ten times more carbon per hectare than a rainforest on mineral soil. The carbon remains conserved only when the peat is permanently saturated with water. Draining peat and other highly organic soils leads to very high carbon dioxide emissions.

Per hectare, typical tropical peatland has a carbon stock of about 6 tonnes of carbon per cm of peat depth. This means that the equivalent of our above-ground carbon threshold of 75 tonnes of carbon per hectare would be reached with a peat depth of only about 12.5 cm. Other organic soils (i.e. soils with more than 12-20 % of organic carbon by weight) may hold substantial mineral material, but do not contain less carbon than pure peats. When mixed with clay, the carbon density of organic soils does not go below that of the lightest pure peats (about 2 tonnes of carbon per cm depth). When mixed with sand, the carbon density is never below the typical value for peat of 6 tonnes of carbon per cm depth.

Tropical organic soils thus mostly surpass the 75 tonnes threshold with an organic soil layer of more than 12.5 cm thick and always surpass that threshold with an organic layer of more than 37.5 cm thick.

Forests with soil carbon stocks above the 75 tonnes threshold are defined as HCS forests. With this threshold, all peat would be protected irrespective of its exact definition. We recommend the protection of all soils with an organic layer of more than 15 cm in depth as a precaution to ensure that the soil carbon threshold is never exceeded.

3.3 Applying the carbon thresholds

Applying the thresholds proposed above will achieve the following key objectives:

- **No clearing** of Old-Growth forests, forests regrowing after selective harvesting, and secondary forests where above-ground carbon is more than 75 tonnes per hectare.
- **No development** on organic soils (peat and other) where the organic layer exceeds 15 cm in depth.
- **Enable well planned development** by conversion of some forests with above-ground carbon of less than 75 tonnes per hectare, provided that development is carbon neutral, and
- **Encourage development on low carbon lands - currently unused, already cleared or degraded lands** where these are suitable for oil palm.

4 That is, soils containing mostly inorganic matter.
5 See Part 2 of this Study for details.
To make application of the thresholds as simple as possible, we are proposing that they are applied sequentially. First, the above ground carbon is assessed. If this is less than the threshold then the soil carbon is also assessed. Areas that exceed either threshold are defined as High Carbon Stock forests and should not be converted to oil palm.

Applying these two thresholds sequentially, together with the requirement for carbon neutral development, will concentrate new oil palm development on lands with lower carbon stocks, including already cleared or degraded land. We do not recommend varying the HCS+ thresholds for different countries/regions. Heavily forested regions and landscapes contain more opportunities to set aside forests to compensate for higher site-specific losses of carbon as a result of conversion. In regions where most land is HCS, regional planning by governments should determine how best to achieve conservation and development goals while still striving to maintain carbon neutrality. This is a complex area that requires further analysis.

### 3.4 Achieving carbon neutral development

Complementary to the application of the carbon thresholds is the concept of carbon neutrality. A carbon neutral oil palm concession produces zero net carbon emissions to the atmosphere. Within a single concession, carbon losses from forest conversion can be balanced against ongoing carbon sequestration in protected set-aside forests, as well as in oil palm plantations on low carbon stock lands. Where relevant, avoided emissions from peatland rewetting can also be taken into account. The broad concept is illustrated in Figure 3, and detailed examples are provided in a Case Study (see Part 3 of this report). This carbon neutral concept is complementary to the application of the carbon thresholds.

In order to achieve carbon neutral development at the concession level, the concession is mapped into small units. For each unit, we compute the carbon debit or credit (caused by changes in biomass and soils) that would result from the unit being either converted or set aside. This information is then used to guide planning for carbon neutral development.

If there is not enough land within a concession to compensate fully for carbon losses from forest conversion, a commitment to protect forests outside the concession could be taken into account. However, this would apply only to forests managed by the same company and in the same biogeographic region – and only if those forests would otherwise not be protected. In such cases, concession owners will carry a legal liability to maintain carbon neutrality if concessions are sold or converted to other uses. A carbon neutral approach that includes protection of set aside forests requires periodic monitoring to verify the accumulation of carbon stocks (with the first assessment forming part of certification audits to verify that the concession is HCS+ compliant). Further monitoring is required to check that protected forests are accumulating carbon as predicted and that carbon stocks are maintained after the 25 year rotation.

![Figure 3: Schematic diagram illustrating carbon neutral development of oil palm at the concession level. The relative size of the three zones will vary markedly depending on the characteristics of each concession being developed – in many cases protected forests will dominate. HCV, HCS, and other non-HCS forests are set-aside and actively protected so as to help achieve carbon neutrality. Small patches of HCS forest and peat may also occur within the amber zone.](image-url)
Section 4: Ensuring Positive Socio-Economic Outcomes

Positive socio-economic outcomes are a critical foundation for sustainable development, along with protection of ecosystem services. The HCS+ methodology provides flexibility to enable the objectives of protecting ecosystem services and generating positive socio-economic outcomes to be met at the same time.

The oil palm sector has generated substantial development in Malaysia and Indonesia through the creation of employment, tax and export revenues and economic linkages. Smallholders have been an important part of this process, benefiting from the access to capital, new technologies and markets that the plantation sector has provided. However, this positive broader picture needs to be balanced against the more variable outcomes that have sometimes been experienced at local levels. These have included the loss of land without the Free, Prior and Informed Consent (FPIC) of local communities, as well as low wages, unacceptable working conditions, localised environmental damage and flawed smallholder schemes. Our case studies of Indonesia, Malaysia, Nigeria, Liberia and Cameroon analyse aspects of these positive and negative outcomes.

With the current expansion of oil palm into some of the poorest countries in the world in West and Central Africa, a more explicit focus on rights and welfare is now required to ensure that the full potential of palm oil to contribute to local and national development is met, and that any negative impacts are minimised. This focus must involve much better monitoring and auditing of the implementation of existing industry standards established to protect human rights and promote socio-economic benefits, and more precise measurement of welfare outcomes.

Section 5: The HCS+ Socio-Economic Methodology

The objective of the HCS+ socio-economic methodology is to provide the information necessary to enable companies to meet their commitments to protect human rights and to generate socio-economic benefits through their operations. The proposed methodology consists of mechanisms for improved implementation of existing standards by using concrete criteria to assess adherence, and methods for the measurement of the impacts of companies’ operations on community welfare - a new Palm Oil Welfare Index (POWI) is proposed for this. The HCS+ socio-economic methodology can be summarised thus:

**Clear, measurable and objective criteria to verify adherence to existing human rights and welfare standards.** Such criteria should build on existing mechanisms and provide the basis for expanded monitoring and auditing processes.

**An auditing process dedicated to socio-economic objectives.** Dedicated socio-economic auditing should be carried out prior to land conversion (as well as subsequently) in order to ensure that FPIC processes have been fully respected and that livelihood set-asides are adequate for local community needs.

**Standardised procedures for the establishment of fair smallholder models and the provision of social infrastructure.** Companies should negotiate social contracts with communities that establish fair terms for attached small-holders, and set out commitments for the provision or support of social infrastructure such as education and health facilities. These may also include assistance to independent smallholders with improved technologies and market access, as well as plans for community access to and management of environmental set-asides.

**A procedure to monitor the socio-economic outcomes of oil palm development for local communities.** Companies should use established methods such as those included in the new Palm Oil Welfare Index to monitor aspects of welfare including food security, income, and access to clean water and social infrastructure. These methods provide an objective information-base for planning and management to ensure that socio-economic benefits are maximised and any negative impacts minimised.
Part 1: Extended Summary
HCS+: A new pathway to sustainable oil palm development

Table 1: Possible criteria for socio-economic outcomes addressed in existing standards.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Outcome</th>
<th>Possible criteria for verification</th>
<th>Stage of oil palm development for verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>Fair wages</td>
<td>Records of wages; confirmation of wages with employees.</td>
<td>Periodic monitoring after concession established</td>
</tr>
<tr>
<td></td>
<td>Freedom of association</td>
<td>Records of meetings; confidential interviews with employees.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No child/forced labour</td>
<td>Records of the age and status of employees.</td>
<td></td>
</tr>
<tr>
<td>Participatory Process</td>
<td>Participatory process to identify set asides for livelihoods and cultural sites</td>
<td>Multiple lines of evidence to verify participatory process based on village meetings, household surveys, individual interviews with a cross-section of community members, and visits to set asides.</td>
<td>Prior to land conversion; periodic monitoring after plantation established. To verify access to set asides.</td>
</tr>
<tr>
<td></td>
<td>Representation for local communities</td>
<td>Evidence of procedure; interviews with employees to assess awareness of process.</td>
<td>Periodic monitoring after concession established.</td>
</tr>
<tr>
<td></td>
<td>Informed consent from local communities to relinquish land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process for grievances</td>
<td>Social infrastructure</td>
<td>Standard operating procedure in companies to identify and fulfill community needs.</td>
<td>Prior to land clearing as part of a Memorandum of Understanding (MOU) with community and periodic monitoring subsequently.</td>
</tr>
<tr>
<td></td>
<td>Application of POWI to measure welfare impacts of social infrastructure interventions.</td>
<td>Establish base line prior to clearing, and periodic measurement subsequently.</td>
<td></td>
</tr>
<tr>
<td>Inclusion of smallholders</td>
<td>Fair smallholder models</td>
<td>Programmes for technology sharing with smallholders to help obtain certification and improve yields; surveys of smallholders.</td>
<td>Prior to clearing to identify plans; periodic monitoring.</td>
</tr>
</tbody>
</table>

Methods to monitor socio-economic outcomes from oil palm development

Quantitative measures of socio-economic outcomes for local communities are needed to monitor progress, to inform auditing of outcomes and to adapt management approaches where necessary. We propose a practical approach to measure welfare gains and losses to local communities from oil palm development, using a new measure, the Palm Oil Welfare Index (POWI).

The POWI includes four outcome measures of welfare: income generated from oil palm concessions; food security; access to clean water; and access to social infrastructure facilitated by the company (health facilities, schools, and electricity). These four attributes can be combined into a single metric using the following method:

\[
POWI = \sum_{i=1}^{n} \frac{x_i}{n}
\]

where \( x_i = \) percentage of households with attribute \( i \) and \( n \) is the number of metrics.

The marginal change in welfare is the difference in the POWI over time.

Table 2: Attributes for inclusion in the Palm Oil Welfare Index (POWI).

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Survey component</th>
<th>Score</th>
<th>Metric for POWI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income from oil palm concession</td>
<td>Does a member of your household earn income from the oil palm concession?</td>
<td>1 = yes, 0 = no</td>
<td>Percentage of households with income from oil palm concession</td>
</tr>
<tr>
<td>Food security</td>
<td>Food Consumption Score following WFP methodology</td>
<td>1 = acceptable, 0 = borderline, 0 = poor</td>
<td>Percentage of households with acceptable food consumption</td>
</tr>
</tbody>
</table>
Part 1: Extended Summary
HCS+: A new pathway to sustainable oil palm development

High Carbon Stock Science Study

Sustainable development must always take into account the social, economic and environmental Pillars. At the highest level, land use decisions are affected by drivers that reflect global, national and local-level factors (Figure 4).

HCS+ focuses on improving concession-scale decisions, as summarised in Figure 5 below. In order to generate appropriate local land development options, HCV and HCS+ assessments should be integrated with FPIC processes and the other specified inputs. The HCS+ integrated planning approach described below would replace and extend the current Social & Environmental Impact Assessment (SEIA) process.

Concession-level plans should fit within a larger-scale landscape planning framework, with strong linkages between national, regional and concession-level plans as shown in Figure 6. Such planning is the responsibility of governments, and will thus be guided by national priorities and goals, as well as by input from all relevant stakeholders.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Survey component</th>
<th>Score</th>
<th>Metric for POWI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to clean water facilitated by company</td>
<td>How long does it take to collect enough clean water for your family from the closest source?</td>
<td>1 = &lt;30 minutes, 0 = &gt;30 minutes</td>
<td>Percentage of households within 30 minutes collection time for sufficient amount of clean water</td>
</tr>
<tr>
<td>Access to social infrastructure facilitated by company</td>
<td>How long does it take to walk to the nearest health care facility? Are health care workers and medicines available at the nearest health care facility?</td>
<td>1 = &lt;1 hour and yes to second question, 0 = &gt;1 hour or no to second question</td>
<td>Percentage of households within one hour to adequate health facility facilitated by company</td>
</tr>
<tr>
<td>Has your village have access to electricity and/or lighting? Do you use this electricity and lighting?</td>
<td>1 = yes to both questions, 0 = no to either question</td>
<td>Percentage of households with useful electricity and/or lighting facilitated by company</td>
<td></td>
</tr>
</tbody>
</table>

Section 6: Implementing HCS+ to Support the Sustainable Development of Oil Palm

Sustainable development must always take into account the social, economic and environmental Pillars. At the highest level, land use decisions are affected by drivers that reflect global, national and local-level factors (Figure 4).

HCS+ focuses on improving concession-scale decisions, as summarised in Figure 5 below. In order to generate appropriate local land development options, HCV and HCS+ assessments should be integrated with FPIC processes and

- **NATIONAL LEVEL**
  - Governmental socio-economic goals, forest conservation and emissions reduction targets and legal frameworks.
- **GLOBAL LEVEL**
  - International environmental & socio-economic imperatives and goals.
- **COMPANY LEVEL**
  - People, Planet, Profit.

![Figure 4: Multi-scale inputs into land development decisions.](image-url)
### KEY STEPS IN IMPLEMENTING A HCS+ METHODOLOGY

<table>
<thead>
<tr>
<th>Socio-Economic Considerations</th>
<th>Carbon Considerations</th>
<th>Biodiversity Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiate Free, Prior and Informed Consent (FPIC) processes</td>
<td>Map estimated biomass carbon distribution and soil types across the concession based on remote sensing and field surveys</td>
<td>Map HCV and HCS forest areas</td>
</tr>
<tr>
<td>Map land use and areas used for local livelihoods using participatory mapping within and adjacent to concession</td>
<td>Apply HCS thresholds and rules to define patches for protection or development</td>
<td></td>
</tr>
<tr>
<td>Multi-stakeholder process to identify needs for social infrastructure/development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-stakeholder process to identify areas needed for food security and other livelihoods of local communities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**INTEGRATED PLANNING**

- Map areas of land **not available for conversion** based on: carbon thresholds, HCV, and FPIC that determines local community use
- Estimate and **map potential carbon fluxes (soil + biomass)** that would result from oil palm conversion in available land
- Map options for achieving **carbon neutral development**
  - Provide maps and plans for improved welfare as input to FPIC and multi-stakeholder negotiations
  - **Agreed land development plan**
    - Clear goals for socio-economic and environment considerations
    - Detailed procedures for how to achieve these goals

**National-level plans**

(reflect broad government policies and goals, such as targets for GHG emissions, forest cover, and socio-economic development goals)

**Regional-level plans**

(consider regional context and reflect the regional contribution to national goals)

**Concession (estate) - level plans**

(specify design and management of plantation estates consistent with sustainability principles)

**Figure 5:** Summary of key steps in implementing HCS+ to support the sustainable development of new oil palm plantations. A detailed description of each step is provided in Part 2 of this report.

**Figure 6:** How HCS+, which focuses on concession-level planning, fits into broader land use planning.
Section 7: Convergence with the HCS Approach

The HCS Approach was originally proposed by Greenpeace/The Forest Trust/Golden Agri Resources. This approach used an approximation of carbon stock as a basis for defining forest, and the loss of carbon stock as a basis for defining deforestation. In April 2015, the HCS Approach Toolkit was released which no longer specifies carbon ranges but uses the same vegetation stratification to identify 'viable' forest which is then prioritised for conservation.

While the HCS Approach focuses more on conserving forests, and the HCS+ methodology focuses more on sustainable development, the methods and outcomes may be sufficiently complementary to allow convergence. Discussions underway indicate that there is common ground in application of the patch analysis concepts developed by the HCS Approach, and in the use of LiDAR. There is also agreement on the need for rigorous implementation of HCV and FPIC, and robust support for the rights and needs of local communities. Both the HCS Approach and the HCS+ methodology support the protection of primary forests, as well as forests subjected to previous moderate levels of logging disturbance, and older secondary forests. They also agree that low-carbon scrub landscapes and open land should be priorities for any proposed new development.

The HCS Approach and HCS+ have different approaches to dealing with young regenerating forest. The HCS Approach proposes that such forests should be protected, whereas under HCS+ forests with less than 75 tonnes above-ground carbon are potentially available for development. Both methodologies apply FPIC, community land use mapping and HCV assessments to those forests, but the HCS Approach specifies a decision tree to assess and conserve forest values. Much can be learned by undertaking a series of well-designed field trials where the two HCS methodologies are applied side by side. Discussions are currently underway to make progress towards convergence via such a process.

Section 8: Key Conclusions and Recommendations

1. **Demand for oil palm is likely to increase and play a significant role in the agricultural development of tropical countries with suitable climates and soils.**

   Expansion of oil palm plantations is likely to increase into the future given the projected global increase in demand for vegetable oils, and the fact that oil palm is vastly more efficient in terms of oil yield per unit land area than alternative crops such as soy. This will increase pressure for further conversion of land, including forests. It is therefore crucial, as demonstrated in this Study, that all new developments are well-planned and rigorously implemented, in order to secure the significant potential long-term benefits at the local and national level.

   When oil palm development involves conversion of tropical forests or organic soils, ecosystem services are negatively affected. While in many cases oil palm development has contributed to improvements in socio-economic conditions for local communities, in others, food security and human rights have been negatively affected. Sustainable oil palm development requires that both critical ecosystem services are protected and that local communities benefit.

2. **The HCS+ strategy is a new, integrated approach to the sustainable development of oil palm plantations.**

   The method is built on three Pillars: maintaining critical ecosystem services; ensuring socio-economic benefits for local communities; and enabling economically viable development. All three must be achieved for oil palm development to be sustainable, and there should be no trade-offs between the three Pillars. The HCS+ methodology achieves this by protecting important forests for their carbon and other values; by obtaining carbon neutrality at the concession-level; and by allowing well-planned conversion of some forest land to generate verified, equitable and conflict-free socio-economic benefits for local communities. Our methodology may also have application in dealing with similar development challenges for other crops in the tropics.
3. The HCS+ methodology adopts existing approaches for set-asides to protect High Conservation Value forests, organic soils, and land to satisfy the livelihoods of local communities. But it is not a strict ‘No Deforestation’ approach.

Based on the potential of the oil palm industry to contribute to sustainable development if local communities benefit, HCS+ allows development of low carbon stock land provided that conversion is carbon neutral across a company’s concessions in a biogeographic region.

Neither the HCS Approach nor the HCS+ methodology completely prevents deforestation (as in ‘zero deforestation’), but they both aim to reduce it significantly. **HCS+ ensures no deforestation of HCV and HCS (as defined in this study) forests.** Experience over the last 20 years has taught us that no amount of high-level declarations will protect forests on the ground unless and until local people and communities see that their own economic interests and historic entitlements are better served through forests being set aside and protected for the long-term rather than cut down for short-term gain. We maintain that some level of responsible development, coupled with a strong role for both companies and local communities in the protection and management of set-aside forests is the best way to ensure the long-term protection of tropical forests in many countries.

4. The HCS+ methodology for carbon neutral development has the following benefits:

- It provides an additional mechanism to protect important forests beyond the constraint imposed by HCS+ thresholds.

- It facilitates the planning process by presenting for discussion various land development options in an objective way. Within given constraints, it allows flexibility in the allocation of land within a concession (or across concessions). In this way it can accommodate nationally and locally differing conditions and opportunities. It also challenges the concession holder to explore and benefit from production-relevant ecosystem services (such as carbon storage, water supply) derived from set-aside areas.

- It allows local communities to use set-asides for livelihood needs (such as hunting and harvesting of non-wood forest products), as long as carbon objectives are met.

- It makes the protection of all forest set-asides (HCS, HCV, riparian and others) a direct, binding, and ongoing responsibility of the concession holder. This provides a critical mechanism for ensuring the long-term protection of set-aside forests that currently does not exist. Currently, in many cases, HCV and HCS forests are identified but then not included within the concession boundary, meaning that the developer takes no responsibility for preventing future deforestation or forest degradation in these areas.

Communities themselves should play a central role in this management process in order to promote its effectiveness and provide them with further livelihood opportunities.

- HCS+ seeks to ensure that set-aside forests are effectively protected for the long-term. This effective protection of HCV and HCS forests (including peatlands) and the carbon neutrality of any conversion are the best guarantee that losses of forest values by deforestation and forest degradation are avoided over time. Thus, loss of some non-HCS forest to enable responsible development, may well result in much better overall forest conservation outcomes in the long run.

- It addresses the often neglected but significant issue of carbon in organic soils.

- It allows verification by independent parties.

5. Achieving socio-economic benefits from oil palm development requires clarity over standards, and measurable criteria to assess outcomes. This approach should apply to existing human rights standards and to social contracts between companies and communities.

To ensure that the positive impacts of oil palm development are strengthened, existing human rights standards need to be implemented more effectively, with better auditing and monitoring of adherence using measurable criteria. Companies need to develop transparent social contracts with communities which set out the roles and responsibilities of each including social infrastructure provision and employment creation by the company. The development of a tool to measure various aspects of community welfare, in the form of the Palm Oil Welfare Index (POWI) will allow companies to assess outcomes in relation to their commitments. This will provide clear evidence of positive impacts and inform adaptation where necessary.

6. Under carbon neutral development, the socio-economic implications of the need to protect large areas of set-aside forests need to be further explored.

In addition to the socio-economic outcomes of the traditional oil palm operation, implementation of carbon neutral development, which creates a requirement to protect large areas of set-aside forests, also has considerable socio-economic implications. Although protection will bring additional costs, where development is carbon positive or generates biodiversity benefits there may be opportunities to build linkages to attract external resourcing and to achieve better overall outcomes. There are also opportunities to boost local livelihoods as a result of community involvement in the management of set-asides, with the creation of ‘green’ employment - helping to magnify the positive impacts of existing operations.
7. For large companies and associated smallholders, the following elements of HCS+ should be implemented immediately for new oil palm plantation developments:

- Protect HCS forests, and HCS organic soils using the thresholds provided;
- Protect HCV forests and other riparian set-asides;
- Plan for carbon neutral development; and
- Robustly adhere to existing standards, and make stronger efforts to promote positive socio-economic outcomes and to measure and report effectiveness.

8. For large companies and their attached smallholders, the full HCS+ methodology should be refined and fully implemented for new oil palm plantation developments within 3 years, and sooner if possible.

To achieve this will require comprehensive field studies evaluating the HCS+ methodology in diverse forest systems in differing countries. These field studies should include several in Indonesia, one in Malaysia, and at least one in West/Central Africa. These trials should also explore mechanisms to bring independent smallholders within the HCS+ sustainable development framework. The learnings from the field studies should be incorporated into a ‘Toolkit’ for use by those developing new oil palm plantations.

9. The conservation of HCS forests within new oil palm estates will inevitably increase pressure to convert forests in other places:

This is a form of ‘leakage’, and may also involve clearance to establish other less efficient oil-producing crops (such as rapeseed, sunflower or soybean) if the expansion of oil palm is curtailed. It is unlikely that all leakage can be avoided, but to help reduce leakage, it will be necessary to achieve wide-scale adoption of HCS+ and the effective protection of HCS+ forests that are set aside. Government support will be critical to achieving this. Making the protection of HCS+ forests a requirement for certification under the RSPO, and as a part of the purchasing policies of large companies, will also be important steps.

10. The HCS+ methodology focuses on concession-level development, but governmental planning of land-use at a larger spatial scale would produce greater overall benefits.

Landscape-level plans to identify areas suitable for sustainable oil palm development are required. This requires a more comprehensive approach to land use planning decisions (see Figures 5 and 6). It is much more than repeating land-use planning exercises in many concessions across the landscape. Rather it involves establishing conservation and development goals at much larger scales, and then allocating and managing land to achieve those objectives. This approach will enable new plantation developments to be allocated to areas where environmental impact can be reduced, and where positive socio-economic benefits can be high.

Governments (or relevant state/provincial jurisdictions) must lead such planning, which will be guided by national priorities and goals, by working with all relevant stakeholders including business, NGOs and communities. A recent study in Kalimantan showed that by relocating the development of new oil palm plantations to low carbon lands, GHG emissions could be reduced by 55-60% with very little impact on oil palm profitability. Several significant pilot studies testing the application of a landscape approach to improving the sustainability of oil palm are currently underway in Indonesia.

Landscape planning would also help to deal with the vexed issue of degraded land. We currently have limited knowledge of the area of this land, or of its availability and suitability for growing oil palm at commercial levels of productivity.

11. The HCS+ method could be merged with the HCS Approach to provide clear and consistent guidance for companies and governments.

While the HCS Approach focuses more on conserving forests, and the HCS+ methodology focuses more on sustainable development, the methods and outcomes may be sufficiently complementary to allow convergence of the two. The HCS Approach and the HCS+ methodology are convergent in many respects, although the Approach is cross-sectoral and HCS+ is only for oil palm. Planning is currently underway for joint trials of the two methodologies in diverse forest environments, and the experience and findings from that exercise will be valuable in facilitating further refinement that could hopefully lead to a single HCS methodology for future use by the oil palm sector. Such a methodology would sensibly be governed by the RSPO.

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Carbon leakage: When policy to reduce emissions in one area results in increased emissions elsewhere.
Part 2: Synthesis Report

HCS+: A new pathway to sustainable oil palm development
Executive Summary

1. HCS+ proposes a new pathway to sustainable oil palm development. The Study, focused on Southeast Asia and West and Central Africa, provides:
   - Carbon thresholds to define High Carbon Stock (HCS) forests;
   - Guidance on making reliable estimates of carbon emissions from land conversion;
   - Guidance on achieving carbon neutral development that is economically viable; and
   - Guidance on enhancing human rights and on generating socio-economic benefits.

2. Oil palm development can only be sustainable if it:
   - maintains critical ecosystem services1; and
   - delivers socio-economic benefits for local communities; and
   - is economically viable.

These three Pillars are independent, i.e. do not allow trade-offs between them.

The HCS+ methodology aims at constraining greenhouse gas emissions while protecting important forests and supporting development. The approach allows the conversion of forests with lower carbon stocks and lower conservation values. HCS+ is thus not a strict 'No deforestation' approach, but precludes deforestation of HCV and HCS forests and ensures carbon neutrality of concession development by balancing carbon losses from forest conversion to oil palm, against carbon sequestration in other parts of the concession.

3. HCS forests have more than 75 tonnes of carbon per hectare above ground or more than 75 tonnes of organic carbon per hectare in their soils. In neither case should the land be converted. These thresholds ensure that new development is concentrated on low carbon stock land, including land already cleared or degraded.

4. Within a single concession, carbon loss from forest conversion can be balanced against carbon sequestration in actively protected set-aside forest, as well as in oil palm plantations on low-carbon stock land. HCS+ requires carbon neutrality (i.e. zero net emissions) of concession development. However, where the area of set-asides is large, development can be highly carbon positive. Importantly, the requirement for carbon neutrality does not replace the constraint imposed by the HCS+ thresholds, but does provides an additional mechanism to protect important forests.

5. Critically, HCS+ provides a practical method for protecting forests that have been set aside for environmental reasons (either as HCV or HCS forests) from progressive degradation, e.g. through encroachment by local communities. HCS+ creates a strong obligation for active protection of set-asides by companies because the set-asides are required for carbon sequestration under a carbon neutral approach to development. Local communities should be closely involved in the management of these set-asides, to help ensure their buy-in to the process and to provide alternative livelihood opportunities.

6. The HCS+ methodology is underpinned by remote sensing technology, used to map:
   - Above-ground carbon using airborne LiDAR;
   - Vegetation and land use in the concession and adjacent areas using high resolution optical satellite data;
   - Peatlands and other organic soils; and
   - Remote sensing also has several other important co-benefits both for planation design, and for quantifying a range of ecosystem services.

7. HCS+ includes measures to assess progress towards the positive socio-economic outcomes that oil palm development can secure. These include more effective ways to monitor and audit adherence to existing human rights standards and related commitments and to verify these aspects. HCS+ also proposes a new composite measure, the Palm Oil Welfare Index (POWI). This index provides a baseline of socio-economic conditions before development, measures subsequent impacts on welfare, and helps companies to identify adaptive actions where necessary in order to maximise their positive socio-economic impacts.

8. In addition to the socio-economics of traditional oil palm operations, implementation of carbon neutral development, which often requires the protection of large areas of set-aside forests, also has major socio-economic implications. Protection brings costs, but where development is carbon positive or generates biodiversity benefits there may be opportunities to attract external resourcing and to achieve better overall outcomes. Further, there are opportunities to enhance livelihoods, including through employment for local communities, and hence to strengthen partnerships with communities in oil palm development.

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1 Ecosystem services: The services people obtain from ecosystems.
9. HCS+ proposes a more integrated planning approach to facilitate sustainable oil palm development. This involves High Conservation Value (HCV) and HCS+ assessments as well as Free Prior and Informed Consent (FPIC) processes and other inputs to produce development plans that take into account socio-economic, carbon and bio-diversity considerations.

10. While the HCS+ methodology and its application are described in reasonable detail in this report, some aspects require further development and field testing. This testing will provide valuable practical experience leading to more cost-effective implementation, which could be captured in the form of a ‘Toolkit’.

11. The HCS+ methodology differs from the other principal initiative in this area - the HCS Approach. For example, the HCS Approach prioritises a ‘No Deforestation’ approach, whereas the HCS+ methodology identifies HCS forests that must be protected, as well as potential land for carbon neutral development. However, HCS+ and the HCS Approach have much in common, and work is underway to bring the two together in a single methodology hosted on a single platform.

2 See http://highcarbonstock.org/the-hcs-approach-toolkit/
Section 1: The Conceptual Basis for HCS+ Methodology

One of the major questions facing us all is this: how can we reduce and eventually eliminate tropical deforestation, while also addressing the need to end chronic poverty in many parts of the world—a need that has led some countries to turn to crops such as oil palm, through the conversion of forested areas? We believe the HCS+ methodology outlined in this report takes us a significant step closer to resolving this question.

Over the next decades, tropical forest land will come under increased pressure from the expansion of oil palm and other crops. There has been strong growth in the oil palm sector during the last decade and this is expected to continue with a strong global increase in demand for vegetable oils (Fry, 2015). Improvements in productivity, especially by smallholders, will go some way to meet this new demand. But there will inevitably be pressure for new planting, even if some of this can be met by planting on already degraded land.

It is vital that any land conversion is done sustainably—that is, that it produces genuine economic and social benefits while avoiding unacceptable environmental damage. Done well, the conversion to oil palm of tropical forests with low-carbon stock can contribute significantly to sustainable development. Done poorly, it leads to adverse social outcomes such as loss of rights and livelihoods. It can also cause loss of biodiversity, damage to soil and water, and large emissions of greenhouse gases. For example, Agus et al. (2013) estimated that land conversion to oil palm in Indonesia, Malaysia and Papua New Guinea during the period 2006-2010 caused about 20% of the greenhouse gas emissions from all land use change in the region, whereas progressive degradation of natural forests by logging and fire caused the bulk of the emissions. These degraded forests are often subsequently converted to oil palm (Gunarso et al. 2013). That said, good land use planning decisions within oil palm landscapes can be highly beneficial to both carbon and biodiversity (Lucey et al. 2015).

This Study builds on other work aimed at improving the sustainability of palm oil production, primarily through the Roundtable on Sustainable Palm Oil (RSPO). This voluntarily implemented certification process includes High Conservation Value (HCV) assessments; ensuring the Free, Prior and Informed Consent (FPIC) of local communities; and other social and environmental impact assessments.

Our Study concentrates on concession level processes, but within the context of the larger landscape as far as this is relevant for operational management of concessions—for example, with respect to hydrology, settlements and land use. Our Study has a geographical focus on Southeast Asia and West and Central Africa.

The HCS+ methodology provides criteria to identify forests and soils that should not be converted to oil palm—thereby safeguarding ecosystem services. Areas that do not match these criteria can be converted. However, HCS+ proposes that, at the concession level, carbon losses from conversion should be balanced by carbon gains, to achieve carbon neutrality across the concession as a whole (see Section 3.4).

The HCS+ methodology places a strong emphasis on constraining carbon emissions within a framework that protects important forests but also supports sustainable development, including through the conversion of some forests to oil palm plantations. The ‘HCS’ in the name relates to a significant focus on carbon emissions—which impact adversely on global climate. The ‘+’ indicates that there will be opportunities for improved livelihoods by allowing some level of responsible conversion of forests to oil palm plantations.

HCS+ provides a process (see Section 6) for the integration of HCS considerations with HCV, FPIC and other important inputs to support the sustainable development of new oil palm plantations. Integration is achieved using a comprehensive multi-stakeholder process to determine the acceptable location and magnitude of future land conversion to oil palm (Figure 5). However, in the HCS+ methodology, reliable estimates of carbon stocks are critical, because these are used to define High Carbon Stock forests (Section 3.1) and to underpin planning for and verification of carbon neutral development (Section 3.4).

HCS+ also sets out three requirements or ‘Pillars’ needed for oil palm development to be considered sustainable (Figure 1). These three Pillars must be constructed independently, without trade-offs between them. The three Pillars are:

**Pillar 1: Land conversion for oil palm plantations must maintain critical ecosystem services.**

Tropical forests provide multiple ecosystem services. At the global scale, tropical forests and soils help regulate climate. When land is converted to oil palm plantations, carbon stored in biomass and in soils is released to the atmosphere as a greenhouse gas. Tropical forests also harbour more biodiversity than any other terrestrial ecosystem. At the local scale, tropical forests produce many other benefits. These benefits include protection of watersheds from erosion, and support for plants and animals that provide food security and livelihoods for local communities.
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Pillar 2: Oil palm development must ensure socio-economic benefits for local communities.

Carefully planned and executed oil palm development can benefit local communities by providing access to employment and services. It can also contribute to economic development at the regional and national scale. Conversely, inappropriately planned and executed oil palm development can violate human rights by displacing local people without compensation or consent, and by creating food insecurity in local communities as a result of severing access to traditional food sources. The HCS+ methodology allows Pillars 1 and 2 to be achieved simultaneously – and without net carbon emissions – through carefully planned and executed oil palm development.

Pillar 3: Oil palm development must be economically viable.

The economic viability of oil palm concessions is highly dependent on maintaining low production costs and on obtaining high yields. Only if both are achieved can reasonable revenues and profits be produced. Therefore the HCS+ methodology proposed for Pillars 1 and 2 must be practical and cost-effective. It must, for example, take account of the increased production costs (resulting from, for example, additional management or lower yields) that may result from prioritising land conversion in locations with poor soils, or on degraded land, or in areas with seasonally dry climates (Goh et al. 1994; Pushparajah, 2002).

Figure 1: The three Pillars of the HCS+ methodology that underpin the sustainable production of palm oil. They must be constructed independently, without trade-offs between them. The blue boxes summarise major components/mechanisms of the HCS+ methodology – cost-effective implementation of these will contribute to economic viability.

Adherence to the HCS+ methodology has the potential to produce many benefits for oil palm producers. These benefits include:

- Access to markets that demand more stringent practices for the production of sustainable palm oil;
- A stable workforce for supporting services such as land clearing, construction work, planting, logistic support and the management of plantations and forest set-asides; and
- Improved relations with local communities, which can reduce conflicts over land and facilitate operations.

Specifically, HCS+ provides:

- Carbon thresholds to define High Carbon Stock forests and High Carbon Stock soils. These lands should not be converted because they contain not only High Carbon Stocks but also other important forest values that may not be covered by HCV assessments³, which focuses only on HCVs of ‘outstanding’ value.
- Guidance on how to make reliable estimates of carbon emissions from land conversion, and how to achieve carbon neutral development.
- Guidance on how to enhance the protection of human rights and how to ensure positive socio-economic benefits.

All this, together with other inputs, can be integrated through the participation of multiple stakeholders to produce robust land-use and land management plans (see Section 6).

Footnote:
³ A high conservation value area (HCVA) is an area that contains one or more High Conservation Values (HCVs). HCVs are biological, ecological, social or cultural values considered outstandingly significant or critically important, at the national, regional or global level. HCV assessments is a process to identify, manage and monitor HCVA. For more on this see www.hcvtcouncil.org/what-s-hcvf
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Section 2: The Role of Mapping and Remote Sensing in HCS+ Methodology

The HCS+ methodology uses remote sensing in four ways:

- Mapping above-ground carbon using airborne LiDAR (supported by forest inventory)
- Mapping vegetation and land use in a concession and adjacent areas using high resolution optical satellite data
- Mapping peatlands and other organic soils using remote sensing data
- Helping locate important conservation values and associated environmental services

2.1 Mapping above-ground carbon

To identify High Carbon Stock forests, we recommend a combination of airborne LiDAR calibrated using forest inventory (where data is gathered on the ground).

Airborne LiDAR is used to make high-resolution, continuous maps of above-ground carbon. This methodology is robust and non-controversial and allows reliable identification of the size, location and carbon content of also small forest patches, a critical issue for the delineation of HCS forests and the design of new oil palm plantations. Using LiDAR for this purpose is now widely accepted and readily available through specialised survey and consulting firms. Costs are falling.

Accurate carbon-mapping using LiDAR can only be achieved if the LiDAR output is carefully calibrated using on-the-ground forest inventory data with respect to tree heights, trunk diameters and wood density. Using LiDAR alongside forest inventory is the most cost-effective way to produce detailed spatial information on above-ground carbon with the accuracy necessary to identify High Carbon Stock forests (Figure 2). Using LiDAR means that application of the Forest Patch Analysis Decision Tree described in the HCS Approach Toolkit could be greatly simplified.

At the concession scale (5,000–100,000 ha), full area LiDAR coverage costs US$5–15 per hectare depending on the remoteness, size, accessibility and complexity of the area. The per hectare costs drop with the size of the area.

The costs would be borne by the concession holders. For supported smallholders, the costs should be integrated into existing support schemes. For independent smallholders, new financial support schemes would have to be developed – for example, through an HCS+ smallholder co-operatives or through existing certification schemes such as the RSPO.

For more detail on our approach and on the technical parameters we are proposing for LiDAR data collection and processing, see Appendix 1.

2.2 Mapping vegetation and land use in the concession and adjacent areas using high-resolution optical satellite data

Information about the ecosystem surrounding a planned concession provides important context to guide decisions within the concession boundary. Therefore a map of areas adjacent to the concession is needed. The map should put the concession into a landscape context, and include land cover and land use, hydrological catchments, adjacent conservation forests, agricultural patterns, and road and settlement infrastructure. The spatial extent of this map will be defined by administrative and/or ecological boundaries.

There are various types of remote sensing technology that could be used for this task. However, our judgement is that the current best combination of cost and benefit comes from using high resolution sensors such as RapidEye or new SPOT, in combination with medium resolution data from Landsat or Sentinel, supplemented with GIS data. RapidEye data costs are between US$1-2 per square kilometre. Landsat data is free.

2.3 Mapping peatlands and other organic soils

Tropical peatlands are difficult to access, making field mapping problematic. However, remote sensing, in combination with available map information and targeted ground sampling, gives a good balance between comprehensiveness and accuracy. Remote sensing and existing data allows a preliminary detection of major tracts of peatlands/organic soils. These findings must then be validated through ground sampling. Both steps require the involvement of experienced landscape and peatland ecologists (Ballhorn et al. 2011; Jaenicke et al. 2008).

For more detail on the suggested approach to mapping peatlands and other organic soils, see Appendix 1.

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4 LiDAR: Light Detection and Ranging - remote sensing technology measuring distance by illuminating the target with a laser and analysing the reflected light.
5 See: www.highcarbonstock.org/the-hcs-approach-toolkit/
6 These range from low resolution sensors such as Terra or Aqua/MODIS, through medium and high resolution, to the new generation of very high resolution satellites such as IKONOS and WorldView.
2.4 Remote sensing and ecosystem services

Protecting ecosystem services is one of the HCS+ Pillars, and as well as helping to protect carbon stocks, remote sensing also provides valuable information to help protect other ecosystem services. In particular, highly accurate LiDAR mapping provides information on forest structure which helps to identify High Conservation Value (HCV) areas. They can also be used to calculate canopy height and the availability of light under the canopy - metrics that predict the local habitat of endangered species. This information can be used to identify wildlife corridors and priority areas for conservation.

Protecting riparian ecosystems and water quality in oil palm developments is very important. LiDAR produces very precise mapping of drainage systems and periodically flooded areas, which enables better design of drainage and road systems, and effective buffer zones to be designed to minimise the impacts of soil erosion. This protects a key ecosystem service and also holds the potential to provide economic value for growers.

Fieldwork is an essential part of quantifying ecosystem services. Remote-sensing enables the fieldwork to be focused more precisely and enables the ground surveys required for HCV assessments and the HCS+ methodology to be carried out more efficiently.

Figure 2: How LiDAR can be used to identify High Carbon Stock forest at the concession level.

a) Aerial image of a tropical forest canopy.

b) Enlargement of the area shown by the red rectangle in (a) allows individual tree crowns to be identified.

c) LiDAR is used to measure tree height and crown diameter of individual trees.

d) Using the correlation between vegetation height and structural metrics, and biomass data collected in the field, above-ground carbon can be estimated.
Section 3: HCS+ Methodology for Estimating Carbon Stocks and Achieving Carbon Neutral Development

There are many reasons to be concerned about the potentially damaging impacts of converting tropical forests to oil palm development. From a global perspective, in addition to loss of biodiversity, a key potential impact is the contribution to climate change made by the release of carbon stored in forests when conversion takes place. This chapter concentrates on these carbon-related aspects: how to estimate carbon stocks in forests; what carbon threshold to set, above which no development should take place; and how to allow some oil palm development while also achieving carbon neutrality.

But these are not the only concerns. From a local or regional perspective there are other, no less significant, issues. Chief among these is the potential damage to ecosystem services (that is, the benefits ecosystems provide to people). These services include flood and erosion control, water purification, the provision of drinking water, and the livelihoods of people dependent on the existence of well-developed forests.

Where climate is concerned, there is no threshold above which emissions become relevant, and below which they are no longer relevant. All emissions, big and small, contribute to the undesirable build-up of greenhouse gases in the atmosphere. The determination of a carbon threshold can therefore not be based only on climate considerations, but must build on general and widely accepted notions of what constitutes ‘a significant forest’. This includes not just its carbon stock, but also its ecosystem services and biodiversity.

3.1 Forests and carbon

Carbon is stored in forest biomass and in soils. The amounts of carbon can be large, but can rapidly decrease following disturbance from deforestation, logging, fire, or drainage of organic soils. The loss of forest carbon stocks contributes to carbon emissions (mainly as carbon dioxide, \( \text{CO}_2 \)) which in turn contributes to climate change.

Biomass carbon

Forest biomass is made up of living and dead trees. This biomass stores a large amount of carbon - 50% of its dry weight is carbon, and forest biomass can store up to several hundred tonnes of carbon per hectare.

Forest biomass has two components – above-ground and below-ground. The larger component (about 75% on average) is above ground - tree trunks, branches, leaves. The rest is below ground – coarse and fine roots. Woody debris (mainly dead and fallen trees and branches, as well as the remnants of logging) can also store significant amounts of carbon. Some studies (Pfeifer et al. 2015 and references therein) suggest that including woody debris increases above-ground biomass by 10 to 20%.

As forests grow, both above-ground and below-ground biomass increase. When forests are cleared the biomass oxidises and the carbon it contains is released to the atmosphere as carbon dioxide. For accounting simplicity these \( \text{CO}_2 \) emissions are often assumed to take place as soon as clearance happens. But in reality the carbon may be released over many years as the wood slowly decays.

Soil carbon

Carbon found in soil is the other principal stock of carbon in forests. Soils vary greatly in their carbon stocks. A hectare of sandy mineral soil can contain less than 100 tonnes of carbon, while the same area of deep peat can contain many thousands of tonnes of carbon. Forest conversion on carbon-poor soil will produce relatively low emissions. Carbon losses from mineral soils take place slowly after conversion - unless the conversion involves substantial earthworks and movement of soil. But draining peat and other organic soils can produce large losses of carbon - annual emissions of between 10 and 20 tonnes of carbon per hectare can result. Peat fires can also cause significant losses of carbon over a very short period of time.

Calculating net carbon losses and gains

When calculating the net loss of carbon caused by converting forest to oil palm planting, the relevant baseline for comparison is what would have happened to the land without conversion. Thus, it is not just carbon losses from the existing biomass that have to be taken into account. The future carbon sequestration that is foregone by removing the forest also has to be accounted for or alternatively the future carbon losses that would result from uncontrolled degradation if the forest were not converted to oil palm.

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7 That is, soils containing mostly inorganic matter.
That said, conversion can itself bring compensating gains as the newly developing oil palms themselves sequester carbon and build up a new carbon stock. When cleared land or grassland is converted, the gain in carbon stock in the oil palm biomass over the 25 year crop cycle may exceed the losses of carbon from the converted land.

3.2 Defining carbon thresholds

Carbon thresholds are central to the HCS+ methodology. These thresholds are set according to the amount (tonnes) of carbon estimated to exist per hectare of land before conversion. The thresholds are used to identify land and forest that must be protected and land and forest that can be converted.

The HCS+ methodology uses two thresholds, one for above-ground carbon, and the other for soil carbon. We have set both thresholds at the same level: 75 tonnes of carbon per hectare. The reasoning behind this is set out below.

Above-ground carbon threshold

To define the above-ground carbon threshold, our main metric used is above-ground biomass carbon. This metric does not include deadwood carbon on the forest floor and therefore does not represent the total above-ground carbon stock.

We use biomass carbon because of the difficulty of assessing levels of deadwood carbon using the remote sensing technology that underpins the HCS+ methodology (see Section 2). In any case, including deadwood carbon in the accounting of above-ground carbon would only make a significant difference in partially logged forests, and these tend to be above our threshold of 75 tonnes of above-ground carbon per hectare.

We have set this threshold guided by a global overview (summarised in Box 2, below) and we use the above-ground carbon threshold to define High Carbon Stock (HCS) forests. These include the largest natural above-ground stores of carbon globally: old-growth forests; managed forests regrowing after selective logging; and secondary forests more than 30 years old. Currently, only 24% of the world’s tropical forests is still reasonably intact (World Resources Institute, 2011), and most of it is un­protected (Mackey et al. 2014). Protecting the above types of forests would limit greenhouse gas emissions, and avoid the loss of biodiversity. These HCS forests should not be converted to oil palm.

Soil carbon threshold

In addition to above-ground carbon, soil carbon also has to be taken into account. This applies particularly to peaty (highly organic) soils. Peatlands are the most significant carbon stores we have. Although they cover only 3% of the land area, they contain more carbon, especially in their peat soils, than the entire forest biomass of the world. A tropical peatland, for example, contains on average ten times more carbon per hectare than a rainforest on mineral soil (Joosten & Couwenberg, 2008).

Per hectare, a typical tropical peatland has a carbon stock of about six tonnes of carbon per cm of peat depth\(^8\). This means that the equivalent of our above-ground carbon threshold of 75 tonnes of carbon per hectare would be reached with a peat depth of just 12.5 cm. It is worth noting that this is well below most authorities’ definition of peat as having more than 30-50 cm of peat depth.

Other organic soils\(^10\) (i.e. soils with more than 20-35% of organic matter or 12-20 % of organic carbon by weight\(^12\)) may hold substantial mineral material, but do not contain less carbon than pure peats. When mixed with clay, the carbon density of organic soils does not go below that of the lightest pure peats (about 2 tonnes of carbon per cm depth). When mixed with sand, the carbon density is never below the typical value for peat of 6 tonnes of carbon per cm depth. Tropical organic soils thus mostly surpass the 75 tonnes threshold with an organic soil layer of more than 12.5 cm thick and always surpass that threshold with an organic layer of more than 37.5 cm thick.

Forests with soil carbon stocks above the 75 tonnes threshold are defined as HCS forests. With this threshold, all peat would be protected irrespective of its exact definition. We recommend the protection of all organic soils more than 15 cm in depth as a precaution to ensure that the soil carbon threshold is never exceeded.

The carbon remains conserved only when the peat is permanently saturated with water. Draining peat and other highly organic soils leads to very high carbon dioxide emissions. It is critically important to avoid development of land with an organic (peat) layer thicker than 15 cm. Developing this land would make it impossible to achieve carbon neutral development.

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\(^3\) There is a strong correlation between above-ground carbon and dead wood (Hérault et al. 2010). In fast-growing, low wood density tropical forests in Southeast Amazonia, carbon in dead wood was about 10% of above-ground carbon stock (Baker et al. 2004). In contrast, in a slow-growing, high wood density tropical forest in Venezuela, it was almost 20% of above-ground carbon stock (Saldarriaga et al. 1988). In Southeast Asia, dead wood ranged between 20 and 60 tonnes per hectare (Pfeifer et al. 2015) that is, within the same percentage range as other tropical forests. In disturbed forests, stocks of dead wood are proportionally much larger. They contributed as much as 30% of total aboveground carbon stocks in twice-logged forests in Sabah, Malaysia (Pfeifer et al. 2015).

\(^4\) That is, carbon density of 0.06 grammes of carbon per cubic metre (Dommain et al. 2011; Warren et al. 2012)

\(^5\) That is, soils largely containing decaying organic matter.

\(^6\) ~12-20 % organic carbon; cf. West et al. 2003, which is in line with the definition of ‘organic soil’ used by the UN Food and Agriculture Organisation (FAO) and the IPCC (Intergovernmental Panel on Climate Change).
Box 2: Above-ground carbon stocks in tropical vegetation

Information on above-ground biomass and carbon stocks in tropical vegetation usually comes from permanent sampling plots. All plants in these plots are measured and the measurements converted into carbon content. For more on this, see Appendix 5. The main conclusions based on a review of the global literature are:

Old-growth forests

Typical above-ground carbon stocks of old-growth forests range between 115-210 tonnes of carbon per hectare, depending on climatic region and soil fertility.

In Borneo, Sumatra and Peninsular Malaysia, old-growth lowland forests hold around 200 tonnes per hectare of live above-ground carbon. Forests on limestone or sandy soils (known as ‘kerangas’ - which are rare and generally unsuitable for oil palm development) have notably lower values, but still hold more than 120 tonnes of carbon per hectare. In the lowland forests of Papua New Guinea, old-growth forests contain around 115 tonnes of carbon per hectare.

In the Central African lowlands, the above-ground carbon stock for old-growth forests is about 180 tonnes per hectare. In the South American lowlands, there is a clear gradient between the fertile areas of Western Amazonia (Bolivia, Peru, Ecuador, and Colombia) and infertile areas of Eastern Amazonia (French Guiana, Surinam, Guyana). In Western Amazonia, the stock is around 115 tonnes of above-ground carbon per hectare, while in Eastern Amazonia, it is around 210 tonnes per hectare.

Managed forests

Managed forests after logging can still hold significant above-ground carbon stocks. After the first cycle of selective logging, forests typically hold about 66% of the original carbon (Bryan et al. 2010). For a forest in tropical Southeast Asia, this represents a stock of about 120 tonnes of carbon per hectare. A second logging cycle soon after the first results in another loss of about 33% of the remaining above-ground carbon. For a forest in tropical Southeast Asia, this would correspond to a remaining stock of 80 tonnes of carbon per hectare, about 40% of the pre-logging baseline. Thus, selectively-logged forests typically still contain 75-140 tonnes of above-ground carbon per hectare after one to two harvests.

Secondary forests

Secondary forests are native forests regrowing after clearance. These forests accumulate above-ground carbon at an annual rate of around 2.5 tonnes of carbon per hectare during the first 30 years across areas suitable for oil palm conversion. There is a wide variation of this carbon accumulation rate depending on the clearing history, soil fertility, how the land is subsequently used, and for how long.

This implies that a 30-year old secondary forest could be expected to have an average above-ground carbon stock of 75 tonnes per hectare. If placed under conservation, such advanced secondary forests will continue to store significant amounts of additional carbon and house considerable biodiversity in the future (Edwards et al. 2011; Laurance and Edwards 2014).

Grasslands, woody savannas or scrublands across the regions of interest are typically low in above-ground carbon, and contain less than 40-50 tonnes of above-ground carbon per hectare.

Oil palm plantations

Oil palm plantations accumulate above ground biomass throughout the life cycle of the plantation (25 years) at an average annual rate of accumulation of about 2.4 tonnes of carbon per hectare, reaching a maximum of 60 tonnes per hectare. The carbon stock averaged over the lifetime of the plantation is thus 30 tonnes per hectare.

For simplicity, only average values are presented. However, empirical data indicate that within the same region two plots of one hectare can vary naturally in their stock by 20% of the mean.
3.3 Applying the carbon thresholds

Applying the thresholds proposed above will achieve the following key objectives:

- No clearing of Old-Growth forests, forests regrowing after selective harvesting, and secondary forests where above-ground carbon is >75 tonnes per hectare;
- No development on organic soils (peat and other) where the organic layer exceeds 15 cm in depth;
- Enable well planned development by conversion of some forests with above-ground carbon of <75 tonnes per hectare, provided that development is carbon neutral (see Section 3.4); and
- Encourage development on low carbon lands - currently unused already cleared or degraded lands where these are suitable for oil palm.

To make application of the thresholds as simple as possible, we propose that they are applied sequentially. First, the above ground carbon is assessed. If this is less than the threshold then the soil carbon is also assessed. Areas that exceed either threshold are defined as High Carbon Stock forests and should not be converted to oil palm.

Applying these two thresholds sequentially, together with the requirement for carbon neutral development (see below), will concentrate new oil palm development on lands with lower carbon stocks, including already cleared or degraded land. However, we caution against assuming that this would apply to very large areas of land. It is likely that part of this degraded land would already have other uses, or may not have the soil or micro-climate suitable for an economically viable crop. (See Appendix 3 for an analysis of Kalimantan).

We do not recommend varying the HCS+ thresholds for different countries/regions. Heavily forested regions and landscapes contain more opportunities to set aside forests to compensate for higher site-specific losses of carbon, provided that sufficient land is available to establish an economically viable crop of oil palm. In regions where all land is HCS, regional planning by governments should determine how best to achieve conservation and development goals while still striving to maintain carbon neutrality. This is a complex area that requires further analysis.

3.4 Achieving carbon neutral development

A carbon neutral oil palm concession produces zero net carbon emissions to the atmosphere.

Complementary to the application of the carbon thresholds is the concept of carbon neutrality. Whilst HCS+ is not a strict ‘No deforestation’ methodology, it does ensure no deforestation of HCV and HCS forests (as defined in this study), and can ensure that zero net carbon emissions can be achieved by balancing carbon losses from forest conversion to oil palm, against carbon sequestration in other parts of the development area. Within a single concession, carbon losses from forest conversion can be balanced against ongoing carbon sequestration in protected set-aside forests, as well as in oil palm plantations on low carbon stock lands. Where relevant, avoided emissions from peatland rewetting can also be taken into account. The broad concept is illustrated in Figure 3.

Figure 3: Schematic diagram illustrating carbon neutral development of oil palm at the concession level. The relative size of the three zones will vary markedly depending on the characteristics of each concession being developed - in many cases protected forests will dominate. HCV, HCS, and other non-HCS forests are set-aside and actively protected so as to help achieve carbon neutrality. Small patches of HCS forest and peat may also occur within the amber zone.
In order to achieve carbon neutral development at the concession level, the concession is mapped into small units. For each unit, we compute the carbon debit or credit (caused by changes in carbon in biomass and soils) that would result from the unit being either converted or set aside. This information is then used to guide planning for carbon neutral development (Box 3). A detailed study of the practical application of carbon neutral development is provided in the Gabon Case Study (Part 3 of this report).

If there is not enough land within a concession to compensate fully for carbon losses from forest conversion, a commitment to protect forests outside the concession could be taken into account. However, this would apply only to forests managed by the same company and in the same biogeographic region – and only if those forests would otherwise not be protected. In such cases, concession owners will carry a legal liability to maintain carbon neutrality if concessions are sold or converted to other uses.

Box 3: The HCS+ procedure to achieve carbon neutrality

1. Using LiDAR (see Section 2) a canopy height map is made of the entire concession. From this, a carbon map can be derived at a 0.25-ha scale. The HCS+ thresholds are then applied to define each 0.25-ha unit as either HCS (High Carbon Stock) or non-HCS.

2. Land identified as having High Conservation Value13 is set aside irrespective of its carbon stock. This land would include, for example, areas of cultural value, riparian areas and animal corridors. The principle of Free, Prior, Informed Consent (FPIC) is also taken into account. An FPIC process might well identify further forest areas to be set aside to meet community needs.

3. Patches of HCS forest smaller than 10 ha in size are unlikely to have long-term carbon or conservation viability because of edge effects, and other causes of vulnerability. This is the minimum area for forest patches resulting from applying the HCS+ methodology. The HCS+ methodology allows some exchange of HCS and non-HCS patches (outside HCV and FPIC areas) to reduce fragmentation and facilitate the practicalities of laying out new oil palm plantations. This means that some HCS patches smaller than 10 ha might be converted and some non-HCS patches protected.

4. A map of organic soils is developed to identify areas of HCS soils which should not be developed. If small patches are developed, then the very high resulting carbon emissions must be accounted for in the calculation of carbon neutrality. The latter also accounts for HCS soils outside the proper plantation area that are indirectly affected, e.g. by drainage.

5. The carbon losses and gains must be estimated robustly and conservatively before conversion (Box 4). A concession achieves carbon neutrality if the total area (including protected set-asides) has a zero or positive carbon balance. Purchase of carbon credits from external sources must not be used to contribute to achieving carbon neutrality.

6. A concession can only be certified under HCS+ when the plausibility of reaching carbon neutrality is and remains carefully verified using LiDAR. Verification should first take place when the concession starts producing oil, i.e. 4-5 years after planting, and should be repeated at least every 10 years, and be followed by final verification at the end of the rotation period. Interim verification must be robust, but does not necessarily have to cover the whole concession. A sampling approach based on LiDAR might be more cost-effective.

7. If the amount of carbon needed to balance losses from oil palm development is not reached by the end of the crop rotation, this failure has to be compensated. A robust mechanism to achieve this has to be developed.

13 The HCS+ methodology uses existing definitions of HCV forests.
In calculating carbon neutrality, the following should be observed (for details see Part 3 of this Synthesis report: Gabon Case Study):

- We only consider greenhouse gas emissions directly associated with the land. We exclude N\textsubscript{2}O emissions from the use of fertilisers, methane emissions from processing, and CO\textsubscript{2} emissions from management and transport, as these emissions occur in all oil palm plantations.
- The time frame used for analysis is the first rotation of the plantation (25 years). In a second (or further) rotation, emissions caused by initial conversion have already been accounted for.
- Carbon contained in biomass, woody debris and soils is upon conversion assumed to be immediately emitted to the atmosphere, as is carbon exported from the catchment (for example, through eroded soil).
- Carbon sequestered by the oil palm crop is taken as the time-averaged carbon stock over the rotation which for planning purposes is taken as 30 tonnes of carbon per hectare (van Noordwijk et al. 2015; Chave, 2015)
- The baseline against which emissions from oil palm are calculated is the level of emissions that would have occurred from the concession area if there had not been an oil palm plantation. We assume a baselines of zero, which is a conservative estimate in a landscape with degrading forest.
- The net effect of oil palm development on greenhouse gas emissions is the cumulative difference over 25 years between the baseline and that of the oil palm estate (including the set-asides). Greenhouse gas emissions are expressed per unit of land area, not per tonne of oil produced.

**Box 4: Accumulation of carbon is set-aside forests**

The carbon neutral procedure of the HCS Science Study assumes that all forests set-aside during the concession planning contribute positively to the carbon balance of the entire concession. These forests may be set aside because they are above the HCS threshold, because they are HCV forests, or because they were excluded following the FPIC procedure. Carbon accumulation in forests has been studied in forests, spanning a wide range of disturbance intensities. There is a wide variation in the carbon accumulation potential of different forest types.

Secondary forests re-growing after clearing accumulate on average 2.5 tC/ha/yr over a 25-yr period (the typical rotation cycle of an oil palm plantation; Chave, 2015). This means that such land set aside for protection would accumulate on average 62.5 tC/ha after 25 years. The typical error on this value is estimated at 17 tC/ha (Chave, 2015), so the effective range of values is 45-80 tC/ha.

Partially-logged forests regenerate differently than secondary forests. Estimates based on a limited number of long-term managed forest experiments suggest that the carbon accumulation rate is closer to 1.5-2 tC/ha/yr (Rutishauser et al. 2015; Chave, 2015). This suggests that the 25-year carbon accumulation potential is 37-50 tC/ha in forests regenerating after partial logging.

Finally, mature tropical forests are also predicted to accumulate carbon as a result of the so-called carbon dioxide fertilisation effect by a magnitude of 0.5-0.9 tC/ha/yr (Pan et al. 2011). This would represent a baseline accumulation of worldwide forests of 12-22 tC/ha over 25 years. However, this effect tends to saturate over time (Brienen et al. 2015) and it is also unclear to what extent secondary and managed forests are sensitive to this fertilisation effect to the same extent as mature forests.

In the HCS Science Study, we assume that most forests set aside have been exposed to prior logging at various intensities and are therefore accumulating carbon. The actual carbon accumulation by these set asides must be estimated by conducting further LiDAR surveys during the rotation after the baseline survey (Box 3). Repeated LiDAR surveys hold a great potential for estimating the carbon accumulation at high spatial resolution (Réjou-Méchain et al. 2015).

For initial planning for carbon neutral development we propose to use a conservative estimate of the carbon accumulation rate, in the absence of robust regional estimates supported by peer-reviewed science. Given the values reported above, we propose that this should be 1.5 tC/ha/yr for typical HCS and HCV forest landscapes in areas exposed to oil palm plantation development. Use of less-conservative values that have not been locally verified, may expose the developer to high risk. Subsequent monitoring will determine whether requirements to achieve carbon neutrality are on track.
Section 4: Ensuring Positive Socio-Economic Outcomes

The HCS+ methodology provides a pathway for the sustainable development of new oil palm concessions. Positive socio-economic outcomes are a critical foundation for sustainable development, along with protection of ecosystem services. HCS+ methodology does not allow these Pillars of sustainable development to be interchanged, for example, through trading off the clearing of High Carbon Stock forests against the employment opportunities created by oil palm concessions. HCS+ methodology provides flexibility to enable the objectives of protecting ecosystem services and generating positive socio-economic outcomes to be met at the same time. This can only be achieved with careful and sustained attention to socio-economic outcomes in the planning and management of oil palm concessions.

The palm oil sector has generated substantial development in Malaysia and Indonesia through the creation of employment, tax and export revenues and economic linkages, as discussed in the case studies (Appendix 5). Smallholders have been an important part of this process, benefiting from the access to capital, new technologies and markets that the plantation sector has provided. However, this positive broader picture needs to be balanced against the more variable outcomes that have sometimes been experienced at local levels. These have included the loss of land without the Free, Prior and Informed Consent (FPIC) of local communities, as well as low wages, unacceptable working conditions, localised environmental damage and flawed smallholder schemes.

With the current expansion of oil palm into some of the poorest countries in the world in West and Central Africa, a more explicit focus on rights and welfare is now required to ensure that the full potential of palm oil to contribute to local and national development is met, and that any negative impacts are minimised. This focus must involve much better monitoring and auditing of the implementation of existing industry standards established to protect human rights and promote socio-economic benefits, and more precise measurement of welfare outcomes.

While improved monitoring and measurement are important goals in themselves, stronger adherence to these existing standards is also necessary to ensure that new requirements for HCS protection can be implemented effectively. Experience in Indonesia, Cameroon and elsewhere suggests that where FPIC for land-use change has not been properly obtained, and where inadequate land is set aside to provide livelihoods for local communities, encroachment into protected areas is more likely to occur (Colchester et al., 2015, p.8-9). On the other hand, greater legal recognition and a central role for communities in the management of set-asides is likely to contribute to better protection (ibid., p.11). The HCS+ socio-economic methodology builds on the standards set out in existing multi-stakeholder processes, especially the Roundtable on Sustainable Palm Oil (RSPO). These take into account labour conditions, land rights based on FPIC, and other socio-economic aspects including protection for the livelihoods of communities affected by oil palm development.16 While some of these standards are detailed and comprehensive, especially those relating to labour conditions, others remain aspirational, with livelihood protection a particularly challenging area that remains under-specified at present. This impedes their effective application, with implementation further hampered by inadequate guidelines for monitoring and auditing. The HCS+ methodology aims to address these shortcomings by establishing detailed and concrete criteria to strengthen adherence to standards, and by promoting better measurement and therefore monitoring of socio-economic outcomes.

There is considerable overlap between protecting rights and promoting welfare. The mechanisms to achieve them are complementary and reinforcing. So the expected positive impact of conducting more effective auditing of FPIC processes, for example, can then be further verified through the measurement of food security outcomes. This methodology can then form the basis for planning and management decisions on socio-economic aspects in parallel to the HCS+ methodology for estimating carbon stocks. All such decisions have to take place within the context of national aspirations and national regulatory environments. Governments are a key stakeholder in the process and their support will be necessary to ensure the effective implementation of HCS+ methodology.

Findings from case studies

The HCS+ socio-economic methodology is largely based on insights from the case studies developed for the HCS Science Study. The objective of these case studies was to generate insights into the socio-economic impacts of oil palm development and the implementation challenges that companies face in their operations. The studies include a selective cross-section of experiences from Southeast Asia and West and Central Africa aimed at providing a comparative analysis of the issues,15 a survey of the institutional framework that governs the industry,16 a survey of stakeholder views on the new HCS requirements,17 (Appendix 5).

14 RSPO Principles 6 and 7, RSPO Next, Palm Oil Innovation Group (POIG), High Conservation Value (HCV) Network, Tropical Forestry Alliance (TFA).
15 Khor et al. (2015); Kasriono (2015); Zen et al. (2015); Gillespie and Harjanthi (2015); Atkinson (2015); Koffa (2015a, 2015b); Thompson et al. (2015).
16 Sukusuan et al. (2015); Perram (2015); Steini et al. (2015).
17 Colchester et al. (2015).
The studies highlight the important contributions of the oil palm sectors in Malaysia and Indonesia, at the national level through export and taxation revenues, and at local level in terms of rural poverty alleviation. Some developments have inevitably been more successful than others. The explicit developmental focus of Felda in Malaysia contributed to its more positive outcome compared to some private-sector led smallholder schemes in Indonesia where outcomes have sometimes been more mixed owing to design and implementation flaws.

The oil palm industry in Africa is far less developed, but has enormous potential to contribute to poverty alleviation and development. There are major informal smallholder sectors in Nigeria and Liberia that produce palm oil at very low yields mainly for domestic and regional consumption. Large-scale investments face serious challenges as a result of unclear land tenure regimes and other governance issues. This has contributed to the lack of investment in the sector in Nigeria as well as the difficulties experienced by the three major international companies with concessions in Liberia. They are now starting to overcome the initial challenges they faced, in part through a recognition of the importance of mutually beneficial relationships with affected communities and improved adherence to RSPO standards, particularly in relation to FPIC. Similar challenges persist however in Cameroon, where RSPO membership is limited.

More effective implementation of these standards in line with the HCS+ socio-economic methodology could help companies overcome some of the governance challenges they face in the African and other settings. More precise measurement of socio-economic impacts would enable companies to demonstrate more clearly their contributions to welfare in line with their commitments, and would help shape further adaptation of their approach in order to maximise these positive impacts.

Felda in Malaysia

The Felda scheme in Malaysia demonstrates the potential positive impacts of oil palm development. Over the period from the late 1950s to 1990, the scheme is credited with lifting 122,000 households - one million people - out of poverty, and creating a rural middle class with land-holdings of an average 4 hectares (Khor et al. 2015). Felda expanded into commercial oil palm estates and ancillary businesses alongside the smallholders. The commercial businesses were publicly listed as Felda Global Ventures (FGV) in 2012 with settlers allocated 800 shares each and a RM15,000 cash bonus.

The scheme was designed and implemented specifically to produce this developmental goal as part of the country’s post-Independence New Economic Policy. It was conceptualised and driven by Tun Abdul Hussain Razak, first as Rural Development Minister and then Prime Minister. His political commitment also helped ensure sufficient land allocations from the state governments of Pahang, Johor and later Sabah, where the schemes were concentrated. Minimum monthly income targets for settlers were set at RM 300 - 50% above the prevailing average. These targets were eventually greatly exceeded, with gross monthly incomes reaching RM750 by the mid-1980s, and more than RM2000 by the late 1990s (ibid).

The direct impacts of the scheme were multiplied indirectly in a number of ways, including through the secondary incomes that settlers were able to earn as contractors to the schemes and by providing economic services to the settlements. The establishment of Felda mills also provided an incentive to independent smallholders, whose supply came to represent a third of total production. Significant up- and down-stream economic linkages were also created in sectors from fertiliser supply to oleo-chemical and food processing. These included numerous ancillary operations set up by Felda itself in related sectors such as transport, security, construction and marketing. Malaysia’s export of palm oil and related products now exceeds that of crude oil.

Elements of the scheme were adjusted as necessary to ensure that its developmental objectives were achieved. These included the design of the smallholder model itself, which had evolved by the mid-1980s into a system of individual land ownership supported by a subsidised loan system, within a broader package including social and economic infrastructure from education to roads. Plot sizes were also increased in order to achieve the income target, from 4 ha originally to 6 ha, while loan repayments were constantly adjusted in response to fluctuating commodity prices. The large number of field staff, with ratios peaking at one field staff for every eight settler households, helped manage these adaptations (Khor et al. 2015).

These complementary inputs carried a price, however, with the total cost per household reaching RM50,000 by the time the scheme ended in 1990, not including any cost for the land itself which had been given free. Approximately RM311.7 million of bad loans had also been written off by then. Much of this funding had been provided by the World Bank and the Malaysia federal government.

The high overall cost raises questions about the extent to which the Felda experience could be replicated today, something which is often advocated given its success. In addition to the required financial commitment, the scheme took place in a very different environmental and political context. While precise information is lacking, earlier schemes involved the loss of hundreds of thousands of hectares of primary and secondary forests, and displaced the indigenous peoples living there. Even if the financial costs could be met through some form of partnership between a government and international development agency, as in the past, such social and environmental costs would clearly be unacceptable today.

However, key lessons can still be drawn from the scheme, in particular the importance of the holistic nature of the approach with its complementary infrastructure and integrated regional level planning, as well as the central role in its evolution that was played by the large numbers of dedicated field staff.

18 See Khor et al. (2015) for more detail.
The objectives and context of Felda have both changed considerably since its transformation into Felda Global Ventures (FGV). One major new challenge is how to achieve the certification of the attached and independent smallholders who continue to supply around two-thirds of the company’s production. While FGV has provided direct support to its attached smallholders as part of its broader management of most of these smallholdings, independents are struggling with existing requirements, let alone any new HCS regulations. If independent smallholders are to be included in the process, the costs of certification will need to be subsidised in some way, whether through provision of direct support by FGV, by accessing the fund that RSPO has established to help smallholders meet accreditation costs, and/or through enhanced market prices (Khor et al. 2015). Governance structures including the Malaysian Palm Oil Board (MPOB) can also play an important role in supporting this process.

Indonesia

In Indonesia, as in Malaysia, oil palm development has generated significant positive impacts for the national economy and has become one of the country’s leading economic sectors. Indonesia surpassed Malaysia as the biggest global producer in 2006, supplying 48% of total global production by 2010 (Paspi 2014). Palm oil is the country’s third largest export after oil and gas and coal, with an annual value of just under US$30bn (Gillespie and Harjanthi 2015, p.6). The industry overall employs around 4.5 million people directly and indirectly (Kasryno 2015). Considerable up- and down-stream linkages have been created, although these are less developed than in Malaysia, with only 6% of exports in the form of processed products (Kasryno 2015). Up-stream development has been greater, in the form of services, including financial and transportation, fertilisers, pesticides and other agricultural inputs (Paspi 2014). Approximately 30% of production is taken up by oil for domestic consumption (ibid.) which has helped limit inflation (Kasryno 2015).

Oil palm development has been concentrated in the states of Sumatra and Kalimantan. The total area planted in Sumatra nearly doubled between 2000 and 2010 from 3.16m ha to 5.96m ha, while employment in the estate crop sector, mainly oil palm, increased by over 1 million households over the same period (Kasryno 2015). The higher rates of GDP that are observed in palm oil producing areas have contributed to poverty reduction (Zen et al. 2015). One study suggested that the rate of poverty in palm oil producing areas ranged between 2-7%, far below the national average of 14% (Drajat 2010 in CIFOR 2014). Another estimated that rural poverty in Riau has fallen from 21% to 10% in the five years from 2009-2013 (Sipayung 2014 in Zen et al. 2015). Recent rigorous econometric research has confirmed this strong correlation between states with higher oil palm production and those with higher rates of reduction in poverty rates (Edwards 2015). This correlation also exists in relation to multi-dimensional measures of poverty which include education and health metrics as well as income. Anecdotal evidence further attests to the transformation of the local economy in many areas. Visible evidence includes a higher incidence of improved houses in villages in oil palm producing areas, as well as a markedly higher presence of consumer goods such as TVs, motorbikes and cars.

Smallholders play a major role within the sector, accounting for more than 44% of national production by 2013, although this figure does include medium-sized producers. The sector originally developed on the basis of the NES (Nucleus Estate and Smallholder) model introduced in the early 1980s, in which state land was allocated to the nucleus estate, which then provided support for the development, technical and marketing aspects for its attached smallholders. Subsequent schemes known as NES-PIR were aimed specifically at trans-migrants from densely-populated states, particularly Java. These early schemes were designed to promote development as in Malaysia, and similarly benefited from support from both the government and international development agencies. As much as 80% of total land area was allocated to the attached smallholders, with the central plantation operating the remaining 20%. Close to 9 million ha has been planted as plasma smallholdings around nucleus estates according to some estimates, with a further 2.875 million ha on individual smallholdings, and the incomes of as many as 3.9 million households have been raised as a result of their participation in the sector (Zen et al. 2015).

The original NES-PIR proportions shifted as the sector became increasingly privatised, and by the late 1990s a new proportion of 80% for the companies and 20% for smallholders had been mandated. Other aspects of the model also changed, with a shift to the so-called cooperative KKPA (Credits Program for Cooperatives) and kemitranaan or partnership models in the 1990s. These involved the establishment of village committees to manage the relationship with the plantation. In some cases, the private plantations took over the entire operation of the smallholdings, paying smallholders a share of profits for the land-holdings allocated to them after deduction of development and operating costs. These changes shaped the impacts of later schemes, which have been more variable than the earlier more developmental ones (Zen et al. 2015).

The earlier schemes included subsidised loans to cover the cost of land, housing and infrastructure and also benefited from the provision of high-yielding varieties and technical support. While challenges were faced during the initial non-productive years, many of those who survived this period have seen their incomes increase (Zen et al. 2015). Trans-migrants generally benefited more than local landowners however (ibid., Asian Agri 2009), as they were worse off initially and did not have to bear the opportunity costs associated with losing their land. Local landowners have suffered from the loss of alternative livelihoods including reduced access to wild sources of food and income as forest areas have contracted. This has at times contributed to increased food insecurity, particularly when insufficient land has been set-aside for communities’ own needs, which has in turn led to encroachment into protected forest areas. (Colchester et al. 2015).

20 Fry (2015) See the Overview Report of the HCS Science Study for this paper.
21 PIR: Perkebunan Inti Rakyat – literally ‘Core of the People’s Estates’.
22 Transmigration: Indonesian government policy to move people from populous to less-populous regions of the country.
Land used by communities and owned under various traditional land tenure systems was often allocated to companies without community consent throughout this period. This practice increased from the early 1990s as forest land became less readily available. This process was facilitated by the prevailing political context during the New Order period, when the state explicitly asserted its right to control land without recognising community rights, and the ability of communities to resist was limited (Zen et al. 2015). Tensions emerged following the fall of the Suharto regime in the late 1990s, with NGOs playing a key role in exposing violations by companies and supporting communities in their (generally unsuccessful) efforts to seek legal redress. This has led to a process of consolidation in which those with access to capital are able to acquire larger plots and achieve higher reported incomes, while those left without land have suffered impoverishment (Zen et al. 2015). This process has served to reinforce existing socio-economic divisions and related power structures. Another outcome has been an increase in the number of landless labourers, often women, with very limited livelihood options, whose wage and labour conditions in the plantations may be undermined as a result (Murray 2015).

The success or otherwise of the later cooperative KKPA and kemitraan schemes has also been dependent to some extent on the effectiveness of their management, which has shaped their relationships with the companies. Where effective management is lacking, attached smallholders may struggle to develop mutually beneficial relationships with the plantation, and are more likely to face issues such as a lack of transparency over pricing and quality of FFBs (fresh fruit bunches), which is a common complaint. Strong management on the other hand may be able to negotiate more beneficial arrangements including more flexible repayment terms and greater provision of support in the form of training or provision of complementary elements such as social infrastructure or income generating programs (Daemeter 2014). These aspects are particularly welcomed by communities, as shown in a survey of one concession in Riau where nearly two-thirds expressed overall satisfaction with the positive impacts of the company, in part due to these additional services (Asian Agri 2009).

The privatisation of the sector has overall been a highly dynamic process that has helped to spread its benefits more widely through the demonstration effect to the still growing independent smallholder sector. However, some of these farmers experience challenges in accessing higher yielding varieties, as well as technical support or training in best agricultural practices. This has contributed to sub-optimal yields, which can be as much as 50% below that of the plantation sector (Zen et al. 2015). Access to markets may also be constrained compared to attached smallholders. Independent smallholders also face considerable difficulties in applying RSPO standards, and as in Malaysia, there is some resistance to the introduction of further new standards. These are widely seen as an unwelcome development given the additional burden that would be created with limited or no reward, as well as the unsatisfactory implementation of existing regulations (Colchester et al. 2015).

Incentives and support will be necessary for the effective extension of these requirements to the large smallholder sector. There is also a need to take account of the legacy of previous engagements between companies and smallholders. Where these have been conflictual and non-collaborative, far greater efforts will be necessary in order to build the mutually beneficial relationships and trust on which effective environmental protection must be based (Gillespie and Harjanthi 2015). Improved adherence to standards and greater transparency regarding company contributions to welfare should contribute to this process.

Again, government actors will also be key to the establishment of effective HCS protection, whether at the plantation or small-holder level. Unlike in Malaysia, current regulations in Indonesia constrain the ability of companies to establish and manage environmental set-asides for both High Conservation Value (HCV) and High Carbon Stock (HCS). Deeper questions of tenure and FPIC rights over environmentally valuable areas also remain unclear. These deeper issues will have to be addressed as part of any effective policy on HCS protection (Colchester et al. 2015).

23 Similar views were reported in Cameroon (Colchester et al. 2015, p.26).
Liberia\textsuperscript{24}

Liberia is one of the poorest countries in the world and it is still recovering from the impact of 15 years of conflict. The oil palm sector has the potential to contribute significantly to vitally urgent national development and poverty alleviation. This potential has been highlighted by projections that suggest the sector could generate up to 90,000 direct jobs, and attract more than US$2bn of investment, creating considerable linkages and multiplier effects. But there are equally significant concerns over whether this model of large-scale plantation agriculture can really produce the kind of sustainable development the country requires. Plantation agriculture, based on rubber production, has a long and chequered history in the country characterised by land expropriation, labour exploitation, profit repatriation, and a lack of value added in the form of any processing of the raw product. Notwithstanding the significant role of the rubber sector as one of the country’s leading economic sectors since the 1950s, it is widely viewed as part of the damaging political economy dynamics that contributed to its deep-seated political crisis.

The initial experiences of the oil palm sector in the country after the end of the civil war, appeared to bear out these fears. Hastily negotiated concession agreements awarded a total of over 600,000 ha of supposedly unencumbered land to three international palm oil companies, much of which was in fact already occupied under customary or private land tenures. The companies then failed to establish effective relationships with the affected communities or to implement adequate FPIC processes or socio-economic assessments before attempting to start their operations. The ensuing conflicts with communities resulted in formal complaints to the RSPO against all three companies, all of which were related to the conversion of land without prior consent. In one case, the failure to leave any buffers for other agricultural activities, and the filling in of swamps that had previously provided a vital source of protein in the form of fish, resulted in increased food insecurity, highlighting again the importance of livelihood set-asides.

All the companies have now undertaken various actions in response to these problems, and the complaints have now been resolved, although some issues remain under observation. As well as implementing far more comprehensive pre-planting social assessment procedures, including participatory mapping as part of FPIC processes, companies have also introduced innovations such as Sime Darby’s Sustainable Partnership Initiative (SPI). This initiative is widely praised as a model mechanism for multi-stakeholder communication that has helped to prevent further conflict from developing. All the companies have also employed social and development staff, although the capacity of these teams varies.

The implication is clearly that a so-called ‘social mandate to operate’ is a necessary foundation for oil palm development in such a challenging operating environment. As the companies themselves all acknowledge, whatever their legal concession agreements say, they would be unable to proceed without a consensual and mutually beneficial relationship with affected communities. Transparent monitoring and verification of this evolving approach, as adopted by one of the companies, Equatorial Palm Oil (EPO) would help to ascertain the extent to which oil palm operations in the country are now fulfilling the required standards, as well as to demonstrate the positive impacts the companies are now starting to have.

These impacts have been limited by various delays, caused by a number of factors. These include the strengthened negotiation and other processes, which have compounded the delays caused by the initial problems. Further delays were caused by the Ebola crisis of 2014/15, which resulted in mill construction timetables being shifted back considerably by all three companies. Two of the companies (Sime Darby and EPO/Kuala Lumpur Kepong Berhad), also introduced a year-long moratorium on new developments as part of the agreement underpinning this HCS Science Study. Less than 35,000 ha had been planted by mid-2015, and fewer than 10,000 jobs created, both far less than original projections. The out-growers schemes mandated as part of all three concession agreements have yet to get off the ground, further limiting the impact of the sector.

Progress has also been held back by the poor state of the country’s infrastructure. The lack of any complementary actions by the government or development agencies to boost agricultural activity or to support small and medium enterprises has impeded the generation of broader economic linkages beyond the direct creation of employment and social infrastructure. The government also lacks the institutional capacity to play the requisite leadership role in the sector, which will limit its ability to contribute to the effective implementation of HCS protection. Support from other stakeholders, including international agencies and the companies, will therefore be necessary.

Notwithstanding these delays, early impacts have been positive and will be greatly magnified as production comes on-stream in all three companies in 2016. Communities in plantation areas have generally welcomed the companies now that the earlier issues have been largely resolved. The impact of the financial inputs from the companies are visible in the zinc roofs that have replaced thatch in these areas for example, although the multiplier effects are limited by the relatively low level of wages in relation to the cost of living. More precise measurement of the impacts of employment creation and social infrastructure provision, such as through the proposed POWI would provide a useful means of understanding better the extent of the welfare benefits of company operations, and could contribute to further improvements.

Concerns remain about the longer-term impacts of the companies’ operations. Even if land is given up gradually and willingly, the large-scale plantation model will inevitably lead to growing pressure on land availability, particularly in the context of the increase in environmental set-asides due to HCS considerations. Such pressures increase the likelihood of encroachment into set-asides as has been seen in Indonesia, a problem that will be exacerbated if livelihood set-asides are inadequate.

\textsuperscript{24} See Atkinson (2015) and Koffa (2015a, 2015b) for more detail.
This appears to be a risk in two of the three concession areas where the introduction of more generous crop compensation rates by the government has created distorted incentives to give up their alternative sources of food and income for short-term gain. If implemented, this may well lead to similar increases in food insecurity as when insufficient buffers were left previously. More generous livelihood set-asides on the other hand would leave sufficient room for out-grower activities, as planned by the third company, GVL, which has adopted this approach, as well as the development of the independent smallholder sector. This would also help to reduce the risk of encroachment on environmental set-asides, highlighting again the extent to which their effectiveness is dependent on robust implementation of rights and welfare standards.

The combination of sufficient livelihood set-asides with environmental set-asides will reduce the overall size of the concessions and require a downward revision of initial projections for the sector. The overall longer term impacts may be more positive however from a smaller plantation sector that forms part of a mosaic of other land-uses including smallholder producers, other agricultural activities, and well-managed environmental set-asides that communities are able to access. With the social licence to operate and the effective implementation of standards, this would represent a very different model from that of the discredited rubber sector, which accounts for 80% of production of the total 2.3m ha planted in the country. Very low yields of around 1.5 metric tonnes of oil per hectare per year are achieved in this sector from mainly wild groves of the unimproved Dura variety using artisanal extraction methods. Yields of at least double the informal producers are achieved by larger smallholdings of Tenera plots, which account for around 200,000 ha, and by larger-scale plantations, which account for nearly 100,000 ha. The market for palm oil is segmented, with most larger producers supplying a higher quality refined SPO (special palm oil) to industrial downstream users, who account for about 19% of domestic production. Around 500,000 metric tonnes of refined oil is also imported annually to service these industries, highlighting the huge potential for boosting local production. One estimate suggests that four companies alone require nearly 95,000 metric tonnes of SPO, which could be met by just 400 efficient small-scale local producers (Thompson et al. 2015). The remaining 81% of domestic production is sold for local consumption. Around 4m people are employed in this informal sector, with average incomes for producers of an estimated US$250/month - exceeding the national poverty level (Thompson et al. 2015).

The sector overall faces major constraints which have contributed to its stagnation over the past few decades, although some growth has been recorded more recently. These include a widespread failure to replant old stock, a lack of access to high-yielding varieties or agricultural extension services, as well as infrastructure deficiencies, with inefficient and expensive transportation contributing to the lack of timely processing. Despite a number of policy initiatives in various areas, there has been very little effective government intervention, mirroring failures in the agricultural sector more broadly. A key challenge relates to land tenure, with uncertainties resulting from the dual customary and formal systems serving as a major disincentive to investment, whether by larger-scale plantations or by smallholders. This dysfunctional land market, which seems to arise more from a lack of government capacity to address it than any intention to expropriate community land for foreign investment as in other countries in the region, represents a constraint described as ‘close to intractable’ (ibid.).

One state, Cross River, has introduced reforms that have contributed to the reinvigoration of the sector there, including investment by international companies such as Wilmar (ibid.). Wilmar’s joint venture with local company PZ is investing US$650m into projects totalling 26,000 ha. The state government here has benefited from far higher revenues than elsewhere from oil resources, and is also participating in pilot REDD projects with substantial financial and institutional support from the United Nations Development Programme (UNDP). Both these factors have boosted its ability to address institutional constraints faced elsewhere in the country, which may not be replicable as a result.

National efforts are underway to address some of the challenges. These include the establishment of a Nigerian Palm Oil Board (NPOB) modelled on that of Malaysia, and the creation of a US$200m Palm Oil Intervention Fund - funded mainly from taxes on imports - some of which will be allocated for subsidised loans for smallholders. However, implementation may face similar challenges as previous efforts, including a lack of continuity owing to administrative turnover, inadequate management, lack of coordination etc. Even if these governance challenges can be overcome, concerns remain about the possible negative environmental impacts from any expansion of the sector, particularly given the weakness of forestry regulations and enforcement. While forest represents only 5-10% of the country’s total land area, at 9m hectares it is still significant. The application of RSPO or other standards including those relating to HCS could contribute to greater protection (ibid.), and the presence of RPSO-compliant companies such as Wilmar is an encouraging sign. The imperative for such companies to ensure compliance as part of protecting themselves from reputational risk could help in the establishment of such international norms in Nigeria and elsewhere where government interest and/or capacity is weak.

The absence of RSPO members in neighbouring Cameroon has conversely facilitated the continuation there of practices that fail to meet international standards, particularly on land tenure and FPIC (Perram 2015). State claims to land override customary rights, which are not generally recognised, and as a result communities play little role in negotiations over land-use and receive limited compensation. This has contributed to their scepticism over the introduction of any new regulations relating to HCS and concern that these would present another mechanism for extinguishing community rights (Colchester et al. 2015). This case highlights the critical role of governments in establishing the context within which voluntary industry-led regulatory practices can be implemented effectively.

Nigeria

Nigeria has a sizeable oil palm sector, with a large informal smallholder sector, which accounts for 80% of production of the total 2.3m ha planted in the country. Very low yields of around 1.5 metric tonnes of oil per hectare per year are achieved in this sector from mainly wild groves of the unimproved Dura variety using artisanal extraction methods. Yields of at least double the informal producers are achieved by larger smallholdings of Tenera plots, which account for around 200,000 ha, and by larger-scale plantations, which account for nearly 100,000 ha. The market for palm oil is segmented, with most larger producers supplying a higher quality refined SPO (special palm oil) to industrial downstream users, who account for about 19% of domestic production. Around 500,000 metric tonnes of refined oil is also imported annually to service these industries, highlighting the huge potential for boosting local production. One estimate suggests that four companies alone require nearly 95,000 metric tonnes of SPO, which could be met by just 400 efficient small-scale local producers (Thompson et al. 2015). The remaining 81% of domestic production is sold for local consumption. Around 4m people are employed in this informal sector, with average incomes for producers of an estimated US$250/month - exceeding the national poverty level (Thompson et al. 2015).

The sector overall faces major constraints which have contributed to its stagnation over the past few decades, although some growth has been recorded more recently. These include a widespread failure to replant old stock, a lack of access to high-yielding varieties or agricultural extension services, as well as infrastructure deficiencies, with inefficient and expensive transportation contributing to the lack of timely processing. Despite a number of policy initiatives in various areas, there has been very little effective government intervention, mirroring failures in the agricultural sector more broadly. A key challenge relates to land tenure, with uncertainties resulting from the dual customary and formal systems serving as a major disincentive to investment, whether by larger-scale plantations or by smallholders. This dysfunctional land market, which seems to arise more from a lack of government capacity to address it than any intention to expropriate community land for foreign investment as in other countries in the region, represents a constraint described as ‘close to intractable’ (ibid.).

One state, Cross River, has introduced reforms that have contributed to the reinvigoration of the sector there, including investment by international companies such as Wilmar (ibid.). Wilmar’s joint venture with local company PZ is investing US$650m into projects totalling 26,000 ha. The state government here has benefited from far higher revenues than elsewhere from oil resources, and is also participating in pilot REDD projects with substantial financial and institutional support from the United Nations Development Programme (UNDP). Both these factors have boosted its ability to address institutional constraints faced elsewhere in the country, which may not be replicable as a result.

National efforts are underway to address some of the challenges. These include the establishment of a Nigerian Palm Oil Board (NPOB) modelled on that of Malaysia, and the creation of a US$200m Palm Oil Intervention Fund - funded mainly from taxes on imports - some of which will be allocated for subsidised loans for smallholders. However, implementation may face similar challenges as previous efforts, including a lack of continuity owing to administrative turnover, inadequate management, lack of coordination etc. Even if these governance challenges can be overcome, concerns remain about the possible negative environmental impacts from any expansion of the sector, particularly given the weakness of forestry regulations and enforcement. While forest represents only 5-10% of the country’s total land area, at 9m hectares it is still significant. The application of RSPO or other standards including those relating to HCS could contribute to greater protection (ibid.), and the presence of RPSO-compliant companies such as Wilmar is an encouraging sign. The imperative for such companies to ensure compliance as part of protecting themselves from reputational risk could help in the establishment of such international norms in Nigeria and elsewhere where government interest and/or capacity is weak.

The absence of RSPO members in neighbouring Cameroon has conversely facilitated the continuation there of practices that fail to meet international standards, particularly on land tenure and FPIC (Perram 2015). State claims to land override customary rights, which are not generally recognised, and as a result communities play little role in negotiations over land-use and receive limited compensation. This has contributed to their scepticism over the introduction of any new regulations relating to HCS and concern that these would present another mechanism for extinguishing community rights (Colchester et al. 2015). This case highlights the critical role of governments in establishing the context within which voluntary industry-led regulatory practices can be implemented effectively.

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23 See Thompson et al. (2015) for more detail.
24 REDD: Reducing Emissions from Deforestation and Forest Degradation - a UN programme to combat climate change.
Section 5: The HCS+ Socio-Economic Methodology

The objective of the HCS+ socio-economic methodology is to provide the information necessary to enable companies to meet their commitments to protect human rights and to generate socio-economic benefits through their operations. The case studies highlight some of the shortcomings of current practice and the importance of developing a systematic approach to address these weaknesses. The consistent, objective and accurate information that the HCS+ methodology proposes (Box 5), provides a strong evidence-base for the planning of new oil palm concessions and the management of existing ones. The proposed methodology consists of mechanisms for improved implementation of existing standards by using concrete criteria to assess adherence, and methods for the measurement of the impacts of companies’ operations on community welfare - the new Palm Oil Welfare Index (POWI). Both aspects are critical to ensure that socio-economic benefits are maximised and any negative impacts are minimised in line with company commitments and aspirations.

These methods require field testing and refinement before being adopted as standard practice through multi-stakeholder agreement. It will be important to ensure their integration into existing mechanisms wherever possible to avoid duplication and minimise the cost and time implications.

Box 5: Summary of the HCS+ socio-economic methodology

The proposed HCS+ socio-economic methodology includes the following:

**Clear, measurable and objective criteria to verify adherence to existing human rights and welfare standards**

Such criteria should build on existing mechanisms and provide the basis for expanded monitoring and auditing processes.

**An auditing process dedicated to socio-economic objectives**

Dedicated socio-economic auditing should be carried out prior to land conversion (as well as subsequently) in order to ensure that FPIC processes have been fully respected and that livelihood set-asides are adequate for local community needs.

**Standardised procedures for the establishment of fair smallholder models and the provision of social infrastructure**

Companies should negotiate social contracts with communities that establish fair terms for attached smallholders, and set out commitments for the provision or support of social infrastructure such as education and health facilities. These may also include assistance to independent small holders with improved technologies and market access, as well as plans for community access to and management of environmental set-asides.

**A procedure to monitor the socio-economic outcomes of oil palm development for local communities**

Companies should use established methods such as those included in the new Palm Oil Welfare Index (POWI) to monitor various aspects of welfare including food security, income, and access to clean water and social infrastructure. These methods provide an objective information-base for planning and management to ensure that socio-economic benefits are maximised and any negative impacts are minimised.
Methods to verify implementation of existing standards

There are more than thirty existing standards addressing socio-economic aspects of oil palm development.27 These standards have been developed through multi-stakeholder processes in the RSPO and related mechanisms. They relate to:

- Labour (fair wages, freedom of association, and child and forced labour);
- The participatory process, including:
  - The Free Prior and Informed Consent (FPIC) of communities in relation to land allocated for concessions;
  - Identification of set-asides for community livelihoods;
  - Establishment of social infrastructure based on local communities’ needs and priorities;
  - The effective representation of local communities in these processes; and
  - Mechanisms for addressing grievances.
- The inclusion of smallholders on fair terms.

Some of these standards are derived from international human rights protocols, including ILO labour standards (ILO 29, 105, 111, 169), the UN Covenants on Economic, Social and Cultural Rights (ICESCR), on Civil and Political Rights (ICCPR), and the UN Declaration of the Rights of Indigenous People (UNDRIIP) (Suksuan et al. 2015). These protocols include protections for the relevant labour, land, food security and cultural rights. The voluntary standards developed by the industry and civil society benefit from being based on these strong international frameworks, which are legally binding for the countries that have signed up to them. Where national commitment is lacking, these mechanisms can provide a useful factor to motivate the adoption of practices that comply with international laws (ibid, 2015), although this is not always the case (Perram 2015). Implementation of these standards is highly variable in practice. Even the long-established High Conservation Value (HCV) system of assessment and verification has only recently been strengthened through the introduction of a quality assurance and licensing system for assessors.

Many elements of the existing standards are statements of broad goals without specific mechanisms for achieving them or for monitoring the extent to which they have been fulfilled. RSPO criterion 6.3, for example, states: ‘There is a mutually agreed and documented system for dealing with complaints and grievances, which is implemented and accepted by all affected parties.’ However, it does not set out any details of such a system. While companies may develop their own interpretations of this standard, its effectiveness cannot easily be assessed without established criteria. The ability to assess whether the standards have been appropriately implemented on the ground is further limited by the inherently qualitative nature of socio-economic outcomes, as well as the remoteness of many concessions with dispersed and diverse local communities.

The HCS+ methodology responds to this clear need by recommending the development of specific, concrete and measurable criteria that can be used to verify the extent to which companies have implemented the requirements of the various standards. Some criteria are fairly straightforward, such as the verification of records of wages and ages of employees. Other standards are less readily amenable to clearly-defined criteria, for example assessing whether communities have freely provided their informed consent to relinquishing land for oil palm development. In such cases, multiple lines of evidence are required to verify that the process has been sufficiently participatory and accepted by the community, including village meetings, household surveys, individual interviews and site visits to set-asides.

A key challenge regarding consent relates to the extent to which unanimity can be expected within diverse communities with different priorities. The concept of participation creates further challenges, and can be used as a mechanism to engineer consent and mask deeper power relations within communities (Gillespie and Harjanthi 2015). Some of these issues are addressed in the revised Guide to FPIC just adopted by the RSPO (FFP 2014). The inclusion in the criteria of individual interviews across a cross-section of community members is one means to verify the extent to which participation has been effective, while sensitivity to these issues on the part of assessors and auditors will also contribute. Remote sensing of concession areas and surroundings recommended for implementing HCS+ methods can also provide critical information to help identify land uses and areas for set-asides as part of the planning process (see Section 2). This information would greatly strengthen existing community land use mapping processes which form the basis of participatory decision-making on conversion and set-asides.

A further challenge relates to the definition of ‘livelihood protection’, with no standardised mechanism for establishing the extent of set-aside requirements either for current or future needs. Community needs are defined through HCV528, but this currently fails to specify the extent of these needs or land required to fulfil them. Instead this process is done on a case by case basis, and may or may not include currently fallow areas that form part of community’s agricultural cycles, or unconverted forests that have been set-aside over a longer period by communities for use by future generations (Colchester et al. 2015). Greater attention is needed to this issue in order to develop more detailed guidelines that can be applied in a standardised way. These will also need to take account of the extent of community access to protected forest areas that supply important livelihood needs.

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27 These standards are listed in Appendix 4.
28 HCV 5: The HCV Approach establishes six High Conservation Values. HCV 5 is ‘Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples (for livelihoods, health, nutrition, water, etc.) identified through engagement with these communities or indigenous peoples.’
Another critical factor in the effectiveness of standards is the timing within the land development process in which auditors assess implementation. Current requirements under the RSPO New Planting Procedures (NPP) which assess the adherence to the original plans only after two years of operations make it difficult to identify potential problems in time, or to prevent companies from deviating from their approved plans. Assessing the participatory process, for example, is far less useful if it occurs after conversion has taken place and options no longer exist to set aside land for local communities. On the other hand, labour standards such as freedom of association need to be repeatedly monitored throughout the lifetime of the concession. Table 1 indicates the stage at which verification should be undertaken for different standards.

### Table 1: Possible criteria for socio-economic outcomes addressed in existing standards.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Outcome</th>
<th>Possible criteria for verification</th>
<th>Stage of oil palm development for verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>Fair wages</td>
<td>Records of wages; confirmation of wages with employees.</td>
<td>Periodic monitoring after concession established</td>
</tr>
<tr>
<td></td>
<td>Freedom of association</td>
<td>Records of meetings; confidential interviews with employees.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No child/forced labour</td>
<td>Records of the age and status of employees.</td>
<td></td>
</tr>
<tr>
<td>Participatory Process</td>
<td>Participatory process to identify set asides for livelihoods and cultural sites</td>
<td>Multiple lines of evidence to verify participatory process based on village meetings, household surveys, individual interviews with a cross-section of community members, and visits to set-asides.</td>
<td>Prior to land conversion; periodic monitoring after plantation established to verify access to set asides.</td>
</tr>
<tr>
<td></td>
<td>Representation for local communities</td>
<td>Evidence of procedure; interviews with employees to assess awareness of process.</td>
<td>Periodic monitoring after concession established.</td>
</tr>
<tr>
<td></td>
<td>Informed consent from local communities to relinquish land</td>
<td>Standard operating procedure in companies to identify and fulfil community needs.</td>
<td>Prior to land clearing as part of a Memorandum of Understanding (MOU) with community and periodic monitoring subsequently.</td>
</tr>
<tr>
<td></td>
<td>Process for grievances</td>
<td>Application of POWI to measure welfare impacts of social infrastructure interventions.</td>
<td>Establish baseline prior to clearing, and periodic measurement subsequently.</td>
</tr>
<tr>
<td></td>
<td>Social infrastructure</td>
<td>Programmes for technology sharing with smallholders to help obtain certification and improve yields; surveys of smallholders.</td>
<td>Prior to clearing to identify plans; periodic monitoring.</td>
</tr>
<tr>
<td></td>
<td>Inclusion of smallholders</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Improving auditing of adherence to standards**

Independent, third-party socio-economic auditing is a critical component of ensuring adherence to existing standards. Current auditing processes within the RSPO take place as part of the New Planting Procedures (NPPs) with a certification audit then carried out two years later. The focus of both processes is on ensuring that the required procedures have been followed, including the ESIA, HCV assessments and FPIC, and that a comprehensive management plan has been developed and implemented based on these assessments (RSPO 2012). Although these audits do help to verify adherence to the standards covered by the assessments, the quality of assessments is generally acknowledged to be highly variable, being dependent to a large extent on the assessors themselves. This aspect has been strengthened recently by the introduction of a formal licensing scheme for HCV assessors. But there is limited evaluation of the way assessments have been conducted, including their sensitivity to complex local realities, or of the extent to which the standards they cover have been met in practice. A field audit is currently optional at both stages (ibid.) so there may be no follow-up with affected communities themselves.
The establishment of the criteria discussed above will aid the auditing process considerably by providing methods and specific criteria against which companies’ operations can be assessed by auditors. For FPIC for example, in addition to checking it has been conducted by a qualified service provider, the audit would include multiple ways of verifying how it was implemented and the views of different members of the community on the process, all in advance of actual land clearance. The POWI in turn then provides the necessary information on which to audit actual outcomes such as impacts on food security, as discussed further below. This data adds a further important layer of accountability as for example the sufficiency or otherwise of the livelihood set-asides determined through FPIC processes will be revealed by the measurement of food security impacts as part of the POWI.

The HCS+ socio-economic methodology recommends that small auditing teams be set up to focus explicitly on the socio-economic aspects of oil palm development. This focused effort would elevate the importance of this area within the broader audit process and help ensure the quality of socio-economic auditors. There appears to be no current requirement for licensed auditors to demonstrate the high levels of understanding of and sensitivity to local context that should be required for this type of exercise. These dedicated socio-economic audit teams should be composed of individuals with appropriate expertise in social surveys and community development, and should include appropriately qualified nationals. To strengthen the credibility of the process, a simple process of formal accreditation of socio-economic auditors could be considered, along the same lines as for HCV assessors. The additional cost of this dedicated team should not be excessive.

Ways to enhance the independence of auditors should also be explored, including through the establishment of an escrow fund into which companies can pay jointly. This would remove the direct link between company funding and the auditing process that exists at present and which may create a distorted incentive to produce positive assessments. Other models of such schemes should be explored to provide guidance for best practice in this area.

Some elements of this socio-economic auditing process must occur prior to any land conversion for oil palm concessions to ensure that FPIC processes have been followed robustly, and that sufficient livelihood set-asides have been defined through a participatory process. After the plantation is established, socio-economic auditing should be carried out periodically to ensure that companies are following the standards. This auditing process should be standardised and applied consistently across companies. As with the establishment of criteria discussed above, the additional steps involved in this socio-economic auditing need to be developed through the testing and further development of the process before being adopted through multi-stakeholder agreement.

Improving socio-economic outcomes for local communities and smallholders

Support for social infrastructure by companies in the form of educational and health facilities, electricity, and wells for clean water, provides considerable additional benefits for communities beyond the direct impacts of company operations. Some companies already sign some form of Memorandum of Understanding (MOU) or social contract with affected communities which sets out their commitments in this regard, including Olam in Gabon and companies in Liberia. The HCS+ methodology recommends that transparent negotiations leading to a mutually agreed social contract should become part of standard operating procedure for all companies where this is not already the case. This will ensure that social infrastructure provision becomes a more predictable aspect of company engagement with communities, which can be audited and is not dependent on the differential abilities of communities to negotiate effectively.

These social contracts should ideally cover all aspects of the relationship between companies and communities, including the terms of attached smallholder arrangements and any assistance to independent smallholders, as well as the terms of community access to environmental set-asides and their role in the management of these. Decisions on provision should be developed through a participatory process in order to incorporate the views of local communities on their needs and priorities. These investments should be designed to complement existing state provision and build local capacities, while usage should wherever possible be extended to the community as a whole rather than only company personnel. Companies should engage community development specialists with local experience to design, implement and monitor the outcomes.

Beyond social infrastructure provision, companies should also consider establishing programmes that generate income and support food security in order to mitigate any negative impacts from the loss of land to the concession and to maximise their overall positive impacts. Support for independent smallholders in the form of access to higher-yielding varieties and associated training would be particularly constructive and benefit from companies’ expertise and the market access they offer.22

Smallholder oil palm production is a key element of companies’ relationships with local communities that can greatly magnify the positive impacts of their operations, as seen in the case studies from Malaysia and Indonesia. These also highlight the essential elements of successful schemes, with effective smallholder schemes in the two countries generally having the following characteristics: access to subsidised funding, especially for development costs and for support during the non-productive initial period of maturation; access to improved technologies, including high yielding varieties and training in agricultural best practice; and access to timely and fair markets. The provision of complementary economic and social infrastructure for smallholders has been a further important element.

22 As set out in Daemeter’s recent case study on Astra Agro Lestari (Daemeter 2014).
Fair models for attached smallholders must be based on these historical experiences of what constitutes good practice, adapted accordingly for local conditions, and should form part of the social contract between companies and communities. These must also take account of new challenges for smallholders that have arisen in relation to the fulfilment of RSPO and other standards. The high costs involved in achieving certification, especially given the limited rewards in terms of price, risk creating a barrier to market access for smallholders (Khor et al. 2015). The difficulties involved in meeting existing standards have also contributed to some resistance to the proposed introduction of further requirements for HCS protection (Colchester et al. 2015). Well-designed smallholder models must take account of these issues and should include assistance with the certification process and training in environmental protection issues as standard, alongside other technical training. While companies should always provide these services for their attached smallholders, they should also consider ways to incorporate independent smallholders in order to limit their potential encroachment on environmental set-asides. Land requirements for independent smallholdings should be considered as part of livelihood set-asides in community land use planning processes.

A further socio-economic consideration that arises directly from the implementation of HCS+ relates to the role of communities in the management of the environmental set-asides that form part of carbon neutral development. While forest protection will incur on-going costs, it also provides livelihood opportunities including employment for local communities. These opportunities may be significant where set-asides are large. This aspect offers a source of considerable potential synergy between the effective management of set-asides and associated positive outcomes in terms of environmental protection, and the maximisation of the socio-economic benefits of palm oil development.

Communication and transparency are key to the establishment of mutually beneficial relationships between companies and communities in all these areas of social infrastructure, smallholdings and management of set-asides. These needs require a commitment to sustained engagement as well as in some cases an acknowledgement of past mistakes, in order to help build or rebuild trust (Gillespie and Harjanthi 2015). These also require genuine participation that is not dominated by more powerful individuals or sections within communities. Mechanisms such as the multi-stakeholder forum established by Sime Darby in Liberia, in which a variety of issues can be fully and safely aired - if not always resolved - in the presence of all relevant actors, could contribute to this process.

While the criteria set out above in Table 1 can help ensure that participatory processes are carried out effectively, communities’ own capacities to participate on more equal terms with the companies also need to be boosted. This can contribute to better outcomes, as seen in Indonesia where stronger village committees are associated with more successful KKPA smallholder schemes (Daemeter 2014).

Training of community representatives in various areas, and the establishment of resource centres with internet access to promote knowledge, understanding and sharing of global experiences and best practices, would contribute to the vital development of local capacity. Support to strengthen local capacity for community land use mapping and planning is a further crucial element of this process.

**Methods to monitor socio-economic outcomes from oil palm development**

Quantitative measures of socio-economic outcomes for local communities are needed to monitor progress, to inform auditing of outcomes and for the adaptation of management approaches where necessary. Numerous welfare measures exist including the Human Development Index (HDI) (Anand and Sen 1994) and the Multi-dimensional Poverty Index (MPI) (Kovacevic and Calderon 2014). But even if they are applied at the local level, these measures are of limited utility for measuring welfare gains and losses from oil palm development. This is because firstly, the measures involve intensive data collection, such as the changes in human body characteristics used in the MPI. Secondly, the attribution of changes specifically to oil palm development is fraught with uncertainty – for example, change in life expectancy used in the HDI could not be attributed directly to oil palm development.

We propose a practical approach to measure welfare gains and losses to local communities from oil palm development, using a new measure, the Palm Oil Welfare Index (POWI). The criteria for developing this measure are:

- **Practicality of data collection in the field with low cost and time investment.** This is a key aspect to ensure that companies are not burdened with additional expensive assessment procedures;
- **The ability to attribute changes in the measures directly to an oil palm concession and company implementation of commitments;**
- **The inclusion of multiple dimensions of poverty in addition to income; and**
- **Based on established and tested survey methods.**

The POWI includes four outcome measures of welfare: income generated from oil palm concessions; food security; access to clean water; and access to social infrastructure facilitated by the company (health facilities, schools, and electricity). These four measures are combined into a single metric, although the individual measures provide insights into the factors contributing to welfare gains and losses. At present, these measures are weighted equally in the metric, although if food security declines then this affects the overall calculation (see below). While the POWI does not currently provide insights on the counter-factual, comparative data for this purpose could be collected from a control site beyond the concession boundary. It also does not at present capture the differential impacts of development within communities or on migrant versus local workers, both of which have been important issues in Indonesia as discussed.
Data need to be collected to establish a baseline prior to oil palm development, and then collected periodically thereafter (every few years) using consistent methods in order to monitor welfare changes effectively. An approximate baseline for income could include information about sources of income prior to the establishment of the concession. Specifics on the methods need to be developed in each situation, for example, local foods need to be identified for the diet survey. A survey sampling method needs to be established to ensure all segments of the population affected by the oil palm concession are represented. The POWI can be implemented by independent researchers/consultants or in-house teams, but in the latter case there would need to be some mechanism to ensure accountability.

To implement the POWI, the following components are to be carried out using household surveys:

1. **Percentage of households receiving income from employment or sale of Fresh Fruit Bunches (FFBs) to the oil palm concessions**

Wages from employment and income from sale of FFBs are the most direct welfare gains from oil palm concessions. We propose that the household survey includes a simple question: Does anyone in your household earn income from the oil palm concession? More information could be obtained on the amount of income and how it contributes to household expenditures, but this single question is the minimum needed for a simple and cost-effective survey. The metric to include in the POWI is the percentage of households receiving income as a direct result of the oil palm concession.

At present, both in the interests of simplicity and to ensure costs and time requirements are kept low, the broader indirect economic impacts of the concession, such as improved road access, higher demand for services etc., are not captured. While these aspects would be relatively complicated to measure, especially given the difficulty of isolating the impact of the concession itself, another metric could be developed if it were thought to add sufficient value to justify the additional complexity.

2. **Food security**

Food security is defined as: ‘when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life’ (Swindale and Bilinsky 2006). Adequate nutrition for household members is the critical outcome of food security. Whether a rural household is food secure depends on the availability, access, and affordability of nutritious food in markets as well as the availability of and access to places to hunt, fish, collect wild foods, grow crops and raise livestock. Measurement of changes in food security will reflect both the expected positive impacts of oil palm operations as a result of enhanced incomes, as well as any negative impacts resulting from loss of access to wild sources of food and income.

There are several well-established methods to assess nutritional adequacy through surveys on diet diversity and food consumption (Swindale and Bilinsky 2006; World Food Programme 2008; Kennedy et al. 2010; WFP and FAO 2012). We suggest the World Food Programme’s Food Consumption Score (FCS) (World Food Programme 2008) as a practical approach. We recommend the use of this approach over the Food and Agriculture Organization’s Household Dietary Diversity Score (HDDS) because the latter accounts for the nutritional density of different food groups while the later provides equal weighting to different food groups. As oil palm concessions can negatively affect protein consumption, with local communities’ loss of access to hunting and fishing, the ability to track protein consumption is important for assessing food security.

The FCS is a composite score based on dietary diversity, food frequency, and relative nutritional importance of various food groups (for example, main staples such as cassava and potatoes, vegetables, meat and fish). Surveys involve a seven day recall of foods consumed and at what frequency (number of days/week). Quantities of food are not included owing to data collection constraints. Food items are grouped into nine food groups based on a country-specific or locally-developed list. Food Consumption Scores (FCSs) are then calculated by summing consumption frequencies of food items in the same group, weighted according to established factors representing nutritional density. For example, meat and fish have two times the weighting of main staples and eight times that of sugar. FCSs are then combined by applying standard thresholds to the FCS to calculate the prevalence of households in each of three groups of poor food consumption, borderline food consumption and acceptable food consumption. If the oil palm concession is in an area with seasonal availability of foods, data collection would need to occur in multiple seasons or in the season with least availability.

The metric to include in the POWI is the percentage of households affected by the oil palm concession with acceptable food consumption.

3. **Access to clean water**

Access to clean water is a critical factor around oil palm concessions. Access can be improved with provision of pumps, or degraded if water sources become polluted with agro-chemicals and sediment from the concession. To assess the status of access to clean water, we recommend a survey question that asks how long it takes to walk to the nearest source of clean water. Households which can collect clean water within 30 minutes in sufficient amounts are considered to have acceptable access based on standards set by the World Health Organization (WHO 2003).
4. **Access to social infrastructure provided by oil palm company**

In remote, poor communities in and around oil palm concessions, oil palm companies’ facilitation of access to health facilities and schools can be a key factor for improving welfare, especially where governments do not adequately fulfil their roles in this regard. Access to electricity and lighting is another important social infrastructure that boosts welfare. We recommend that surveys include information on:

- Health care facilities: how long does it take to walk to the nearest health care facility? Are health care workers and medicines available at the nearest health care facility?
- Educational facilities: how long does it take to walk to the nearest school? Is the nearest school equipped with teachers and educational materials?
- Electricity: Does your village have access to electricity and/or lighting? Do you use this electricity and lighting?

Households within one hour walking distance to health and educational facilities and positive responses to the adequacy of these facilities are considered to have acceptable access. Households in villages with access to electricity and/or lighting and positive response that the household uses these services are considered to have acceptable access. The role of companies in providing these services can be captured in part by comparing data to the baseline, as well as against commitments set out in social contracts.

The metric to include in the POWI is the percentage of households with acceptable access to social infrastructure, with equal weightings to health facilities, schools and electricity and/or lighting. The metric is:

\[ I = 0.33a + 0.33b + 0.33c \]

Where \( I \) is percentage of households with acceptable access to social infrastructure; \( a \) is percentage of households with acceptable access to health facilities; \( b \) is percentage of households with acceptable access to schools; and \( c \) is the percentage of households with acceptable access to electricity and/or lighting.

These four attributes (income from the oil palm concession, food security, access to clean water, and access to social infrastructure) can be combined into a single metric using the following method:

\[ POWI = \frac{\sum_{i=1}^{n} x_i}{n} \]

where \( x \) is percentage of households with attribute \( i \) and \( n \) is the number of metrics.

The marginal change in welfare is the difference in the POWI between time 1 and time 2.

Because food security is an overwhelming concern for welfare loss from oil palm concessions, we recommend that if the percentage of households with acceptable food consumption declines (more than 5% to account for measurement error), then the POWI score for all other components does not increase. The marginal change in the POWI between time intervals would then be negative, signifying an overall loss of welfare despite possible improvements in the other attributes.

The POWI should be assessed before oil palm development and should include all communities to be affected by the development. The pre-development measures serve as a baseline to interpret changes in socio-economic conditions following development. The POWI should be assessed with field data every few years to identify progress and whether there is any need to change management practices.

The proposed metrics for the POWI are summarised in Table 2. As with all composite scores, the POWI combines many complex factors into a single value for the purpose of an overall comparison of welfare at different times or places. This simplified approach should be interpreted with caution and the individual attributes should be considered along with other attributes of relevance in a particular context - when planning and managing the socio-economic aspects of oil palm development. The approach needs to be tested and further refined prior to and following oil palm development and when operational, the survey design and metrics for the individual components should be transparent and openly available.
### Table 2: Attributes for inclusion in the Palm Oil Welfare Index (POWI).

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Survey component</th>
<th>Score</th>
<th>Metric for POWI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income from oil palm concession</td>
<td>Does a member of your household earn income from the oil palm concession?</td>
<td>1 = yes, 0 = no</td>
<td>Percentage of households with income from oil palm concession</td>
</tr>
<tr>
<td>Food security</td>
<td>Food Consumption Score following WFP methodology</td>
<td>1 = acceptable, 0 = borderline, 0 = poor</td>
<td>Percentage of households with acceptable food consumption</td>
</tr>
<tr>
<td>Access to clean water facilitated by company</td>
<td>How long does it take to collect enough clean water for your family from the closest source?</td>
<td>1 = &lt;30 minutes, 0 = &gt;30 minutes</td>
<td>Percentage of households within 30 minutes collection time for sufficient amount of clean water</td>
</tr>
<tr>
<td>Access to social infrastructure facilitated by company (each of the 3 attributes comprises 1/3 of social infrastructure score)</td>
<td>How long does it take to walk to the nearest health care facility? Are health care workers and medicines available at the nearest health care facility?</td>
<td>1 = &lt;1 hour and yes to second question, 0 = &gt;1 hour or no to second question</td>
<td>Percentage of households within one hour to adequate health facility facilitated by company</td>
</tr>
<tr>
<td></td>
<td>How long does it take to walk to the nearest school? Is the nearest school equipped with teachers and educational materials?</td>
<td>1 = &lt;1 hour and yes to second question, 0 = &gt;1 hour or no to second question</td>
<td>Percentage of households within one hour to adequate school facilitated by company</td>
</tr>
<tr>
<td></td>
<td>Does your village have access to electricity and/or lighting? Do you use this electricity and lighting?</td>
<td>1 = yes to both questions, 0 = no to either question</td>
<td>Percentage of households with useful electricity and/or lighting facilitated by company</td>
</tr>
</tbody>
</table>
Box 6: Protection of HCV and HCS forests

Areas of land excluded from conversion to oil palm plantations are often referred to as ‘set-asides’. However, merely ‘setting aside’ is not sufficient to prevent degradation of these areas. Achieving protection of HCV and HCS forests is often problematic, especially in poor and highly populated areas.

The carbon neutral approach of HCS+ uses the additional carbon accumulation in set-aside HCV and HCS forests to compensate for the carbon losses from conversion. The approach thus requires that HCV and HCS forests are effectively protected. This requirement provides a powerful protection mechanism that previously did not exist. Whereas companies formerly avoided HCS forests and were not accountable for ongoing degradation outside their concessions, in the HCS+ methodology companies take responsibility for protecting HCS forests within their concession as a binding obligation. Protection will involve additional costs, but also presents opportunities that are briefly outlined below.

REDD+ mechanisms aim to reduce carbon emissions via the protection and better management of tropical forests, whilst simultaneously improving the lives of the people living in those forests. These goals have much in common with the HCS+ methodology, which proposes protection of important forests, along with careful carbon neutral or carbon positive development that produces positive socio-economic outcomes.

Implementation of HCS+ relates to the following REDD+ activities:

- Reduced emissions from deforestation and forest degradation
- Sustainable management of forests
- Enhancement of forest carbon stocks

Protection of HCV and HCS forests will prevent future deforestation and forest degradation and will increase carbon stocks as a result of on-going forest growth. Under HCS+, only the verified carbon gains from sequestration in protected forests are used to meet the requirement for carbon neutrality, not the likely but harder to quantify avoidance of deforestation and forest degradation. It may be worthwhile exploring to what extent these ‘avoided carbon losses’ can be traded as carbon credits on the compliance and voluntary carbon markets (including for compensating further unavoidable emissions from palm oil production). In landscapes with high cover of HCV and HCS forests, protection of these areas will lead to highly carbon positive development (see Part 3 of this report) and may thus generate tradable carbon credits, when additionality, permanence and avoidance of leakage can be guaranteed. In relation to HCS+, these issues are briefly discussed in Section 3, above.

Any revenues (carbon-related or other) that might accrue from protection of HCV or HCS forests could contribute to the employment of local people to undertake the on-going protection and management of these areas. This will not only improve livelihoods, but also engage communities more effectively in the management of concessions where palm oil production and forest protection are pursued in an integrated way. Collaboration with NGOs and other stakeholders with interest and experience in this area should be sought to strengthen the effectiveness of set-aside management and to provide co-funding.

The synergies between carbon markets and HCS+ for the protection and active management of tropical forests should be further explored. For example, this might involve a more regional or local focus to REDD+ (‘jurisdictional’ REDD, e.g. see Nepstad et al., 2012), with the clear advantage of enhancing private sector and local community engagement in achieving forest conservation and reducing carbon emissions as a part of sustainable development.
As discussed in Section 1, sustainable development must always take into account the social, economic and environmental Pillars, and avoid trade-offs between them. The rights and livelihoods of local communities are a central element that must be respected and cannot be traded off during the process of sustainable development (Colchester et al. 2015).

At the highest level, land use decisions are affected by drivers that reflect global, national and local-level factors (Figure 4).

HCS+ focuses on improving concession-scale decisions, as summarised in Figure 5. In order to generate appropriate local land development options, HCV and HCS+ assessments should be integrated with FPIC processes and the other specified inputs. HCS+ explicitly takes account of three of the values identified under the existing HCV Approach. These are socio-economic aspects covered by HCV 4 (ecosystem services); HCV 5 (communities’ livelihood needs); and HCV 6 (cultural values).

A large part of the challenge of integration relates to ensuring that all required biophysical and socio-economic data is collected at scales relevant to concession-scale decision making. It is critical to define clearly at the beginning of the land development process what information is needed and how it can best be collected. The HCV Resource Network is currently undertaking an analysis to improve the integration of HCV, HCS (as conducted under the HCS Approach) and FPIC processes.

The HCS+ integrated planning approach described below would replace and extend the current Social & Environmental Impact Assessment (SEIA) process. Final land-use decisions and management plans would be developed following analysis, debate and refinement of development options by the relevant stakeholders. The implementation plan should specify clear goals and outcomes and how these will be achieved. It should also specify how progress will be monitored, reported and independently verified.

**Figure 4:** Multi-scale inputs into land development decisions.
**KEY STEPS IN IMPLEMENTING A HCS+ METHODOLOGY**

**SOCIO-ECONOMIC CONSIDERATIONS**
- Initiate Free, Prior and Informed Consent (FPIC) processes
- Map land use and areas used for local livelihoods using participatory mapping within and adjacent to concession
- Multi-stakeholder process to identify needs for social infrastructure/development

**CARBON CONSIDERATIONS**
- Map estimated biomass carbon distribution and soil types across the concession based on remote sensing and field surveys
- Apply HCS thresholds and rules to define patches for protection or development
- Multi-stakeholder process to identify areas needed for food security and other livelihoods of local communities

**BIODIVERSITY CONSIDERATIONS**
- Map HCV and HCS forest areas

**INTEGRATED PLANNING**
- Map areas of land not available for conversion based on: carbon thresholds, HCV, and FPIC that determines local community use
- Estimate and map potential carbon fluxes (soil + biomass) that would result from oil palm conversion in available land
- Map options for achieving carbon neutral development
- Provide maps and plans for improved welfare as input to FPIC and multi-stakeholder negotiations
- Agreed land development plan
- Implementation plan - Clear goals for socio-economic and environment considerations - Detailed procedures for how to achieve these goals

**Figure 5:** Summary of key steps in implementing HCS+ to support the sustainable development of new oil palm plantations.

**Key steps in implementing the HCS+ methodology, summarised in Figure 5:**

1. Map vegetation and land use in the concession and in adjacent areas using high resolution optical remote-sensing such as RapidEye (Section 2). Information for the surrounding forests (such as the continuity of forest cover, location of settlements) provides important context to guide decisions within the concession boundary. In addition, mapping includes socio-economic characteristics. The FPIC process is initiated and participatory mapping undertaken within and adjacent to concession. Baseline data on socio-economic conditions can be collected using the POWI metrics. Identify HCV5 and HCV6 set-asides required for livelihood and cultural purposes.

2. Map estimated above-ground carbon within the entire concession using LiDAR technology appropriately calibrated using biomass estimates made on large plots (of at least 0.25 ha) across the range of biomass likely to occur in the concession (Appendix 1). The above-ground carbon map should have a resolution of 0.25 ha.

3. Map areas of the concession where organic soils exceed 15 cm in depth using a combination of terrain information (from LiDAR), vegetation surrogates, and targeted ground survey (Appendix 1). Presence of these soils will determine a unit of land as HCS, irrespective of the vegetation present (Section 3.1).

4. Apply the HCS+ thresholds for above-ground carbon and soil carbon (Section 3.1) to define each spatial unit as either HCS or non-HCS land. The spatial unit (aggregation) used for further spatial analysis is 10 ha.

5. Land identified as having High Conservation Value (HCV) is set aside irrespective of its carbon stock. This includes land for riparian areas and animal corridors, as well as land with cultural value and areas for current and future livelihoods.

6. The principle of Free, Prior, and Informed Consent (FPIC) underpins all interaction between the company and the community including the development of a social contract between the two parties. This sets out the company’s obligations in relation to employment, social infrastructure and any other commitments, as well as the land to be allocated for oil palm development and for environmental and livelihood set-asides.
7. Identify forest patches that should be conserved, and those that could be converted to oil palm (Section 3.2). Patches of HCS forest smaller than 10 ha in size are unlikely to have carbon or conservation viability in the long-term (see Lucey et al. 2015). In reality much larger patches, of the order of hundreds of hectares are likely to be needed for long-term ecological viability in rainforests (Appendix 2; Lucey et al. 2015).

8. The HCS+ methodology allows some exchange of HCS and non-HCS 10 ha patches (outside HCV and FPIC areas) to reduce fragmentation and facilitate the practicalities of laying out new oil palm plantations. This means that some 10 ha HCS patches may be converted and some non-HCS patches protected. By protecting patches of forest more than 10 ha in size, the HCS+ methodology is precautionary. Further commentary on the relationship between patch size and forest values is included in Appendix 2.

9. Estimate and map the carbon emissions that would result from conversion of land potentially available for new oil palm plantation. Then undertake spatial planning to achieve carbon neutrality at the level of the concession (Section 3.2). This is achieved if the total area (including set-asides) has a zero or positive carbon balance.

10. There are multiple options for achieving carbon neutral development, and this provides planning flexibility. The carbon losses and gains must be estimated robustly and conservatively before conversion, and must be monitored throughout the rotation period, with the first assessment being before the certification audit when oil production commences (to allow for adaptive management if required), and be verified at the end of the rotation period. If the amount of carbon needed to balance losses from oil palm development is not achieved by the end of the crop rotation, this failure has to be compensated. A robust mechanism to achieve this has to be developed.

11. Provide HCS+ outputs as input into multi-stakeholder negotiations leading to an agreed land development plan. The key HCS+ outputs are:
   - Maps that puts the concession into the landscape context, and includes: land cover and land-use, hydrological catchments, adjacent conservation forests, agriculture, and road and settlement infrastructure. The spatial extent of this map should be determined by political, administrative and ecological (for example, catchment) boundaries. The map is derived from high resolution satellite imagery, in conjunction with ancillary GIS data.
   - Maps of potential land available for development after HCS+, HCV and FPIC constraints have been applied as described above.
   - Maps showing different options to achieve carbon neutral development, and options for aggregation and retention of forest patches.
   - Guiding principles for how to boost the positive socio-economic outcomes from the development and minimise any negative impacts.

12. Apply multi-stakeholder processes to produce agreed land use decisions, and a management plan that includes a social contract with local communities. This process should be facilitated either by government agencies, or by an independent facilitator to help ensure fair and robust outcomes.

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**Figure 6:** How HCS+, which focuses on concession-level planning, fits into broader land use planning.

Concession-level plans should fit within a larger-scale landscape planning framework, with strong linkages between national, regional and concession-level plans as shown in Figure 6. Such planning is the responsibility of governments, and will thus be guided by national priorities and goals, as well as by input from all relevant stakeholders.

The HCS+ methodology recognises the imperative for practical application. We are acutely aware that there are already many complex and demanding requirements imposed on the industry. Some of these have a poor conceptual basis, are overlapping, or are currently poorly implemented, thus markedly reducing overall cost-effectiveness. As discussed below, extensive field trialling of several aspects of the HCS+ methodology will guide improved cost-effectiveness.
Section 7: Convergence with the HCS Approach

The HCS Approach as originally proposed by Greenpeace/The Forest Trust/Golden Agri-Resources (2012)

This approach used an approximation of carbon stock as a basis for defining forest, and the loss of carbon stock as a basis for defining deforestation. Their initial approach is summarised in Figure 7, where an above-ground carbon stock threshold of about 40 tonnes of carbon per hectare (with a range of between 25 to 70 tonnes per hectare) was used to define forests and thus set a constraint on forest available for development to oil palm.

Further work was then carried out on the original proposal, and in April 2015, the HCS Approach Toolkit was released. In the Toolkit, carbon ranges are not specified, but the same vegetation stratification is used. The primary objective of this Toolkit is to identify forests that should be conserved, but the method also takes account of the needs of local communities by implementing FPIC as part of the land development decision-making process. All vegetation that is not ‘scrub’ or grassland is considered forest that is potentially worth conserving. These areas (‘patches’) are then subject to an analysis of their likely viability and future value to biodiversity to determine which areas should not be developed.

The HCS Approach is only proposed for use in fragmented forest landscapes. There is no guidance provided as yet on how to address HCS issues in non-fragmented landscapes. Assuming that the current logic applies, there can be no conversion of land to plantations in such landscapes, or indeed in concessions where there is no scrub, grassland or cleared land.

Figure 7: High Carbon Stock (HCS) forest stratification in tropical forests, adapted from the HCS Approach (2014), Golden Agri-Resources and SMART (2012), and Greenpeace (2012).
While the HCS Approach focuses more on conserving forests, and the HCS+ methodology focuses more on sustainable development, the methods and outcomes may be sufficiently complementary to allow convergence of the two. Discussions underway indicate that there is common ground in application of the patch analysis concepts developed by the HCS Approach, and in the use of LiDAR as an approach for deriving biomass maps and mapping organic soils which are part of HCS+. As discussed above, application of LiDAR also has considerable co-benefits in improving other assessments and in supporting better plantation design, layout and management.

There is agreement on the need for rigorous implementation of HCV and FPIC, and robust support for the rights and needs of local communities. HCS+ proposes the introduction of robust criteria to track whether FPIC and other relevant rights-based standards have been well implemented. HCS+ also proposes more pro-active and verifiable approaches to ensure that socio-economic benefits accrue to local communities by using specific measures of welfare impacts in the proposed Palm Oil Welfare Index (POWI).

Both the HCS Approach and the HCS+ methodology support the protection of primary forests, as well as forests subjected to previous moderate levels of logging disturbance, and older secondary forests. They also agree that low-carbon scrub landscapes and open land should be priorities for any proposed new development.

The HCS Approach and HCS+ have different approaches to dealing with young regenerating forest. The HCS Approach proposes a lower above-ground carbon threshold than the HCS+ methodology. The HCS Approach threshold is about 40 tonnes per hectare, with a range of 25-70 tonnes per hectare (Figure 7); it also aims to protect all young regenerating forest. Our threshold is designed to protect all regenerating forests with more than 75 tonnes of above-ground carbon per hectare while also providing opportunities for well-planned development provided that carbon neutrality can be achieved (Section 3.2 and 3.3). Both methodologies apply FPIC, community land use mapping and HCV assessments to those forests, but the HCS Approach specifies a decision tree to assess and conserve forest values.

Much can be learned about differences in conservation and development outcomes in diverse forest environments by undertaking a series of well-designed field trials where the two HCS methodologies are applied side by side. This would also provide valuable experience on the practicalities of implementation and on the challenges, risks and benefits of applying the carbon neutral approach. These trials are intended to inform further discussions about the possibilities for further convergence or complementarity. Discussions are currently under way to make progress towards convergence via such a process.

There are other important issues that will need to be jointly addressed. These include: how to ensure that HCS and HCV forest is not only identified but effectively protected in cooperation with any affected communities; how to achieve future integration of HCS/HCV and FPIC; who should administer and apply any converged HCS methodology; and how to apply no-deforestation commitments in high forest cover regions.
Section 8: Key Conclusions and Recommendations

1. Demand for oil palm is likely to increase and play a significant role in the agricultural development of tropical countries with suitable climates and soils.

Expansion of oil palm plantations is likely to increase into the future given the projected global increase in demand for vegetable oils, and the fact that oil palm is vastly more efficient in terms of oil yield per unit land area than alternative crops such as soy (Fry, 2015). This will increase pressure for further conversion of land, including forests. It is therefore crucial, as demonstrated in this Study, that all new developments are well-planned and rigorously implemented, in order to secure the significant potential long-term benefits at the local and national level.

When oil palm development involves conversion of tropical forests or organic soils, ecosystem services are negatively affected. While in many cases oil palm development has contributed to improvements in socio-economic conditions for local communities, in others, food security and human rights have been negatively affected. Sustainable oil palm development requires that both critical ecosystem services are protected and that local communities benefit.

2. The HCS+ strategy is a new, integrated approach to the sustainable development of oil palm plantations.

The method is built on three Pillars: maintaining critical ecosystem services; ensuring socio-economic benefits for local communities; and enabling economically viable development. All three must be achieved for oil palm development to be sustainable, and there should be no trade-offs between the three Pillars. The HCS+ methodology achieves this by protecting important forests for their carbon and other values; by obtaining carbon neutrality at the concession-level; and by allowing well-planned conversion of some forest land to generate verified, equitable and conflict-free socio-economic benefits for local communities. Our methodology may also have application in dealing with similar development challenges for other crops in the tropics.

3. The HCS+ methodology adopts existing approaches for set-asides to protect High Conservation Value forests, organic soils, and land to satisfy the livelihoods of local communities. But it is not a strict ‘No Deforestation’ approach.

Based on the potential of the oil palm industry to contribute to sustainable development if local communities benefit, HCS+ allows development of low carbon stock land provided that conversion is carbon neutral across a company’s concessions in a biogeographic region.

Neither the HCS Approach nor the HCS+ methodology completely prevents deforestation (as in ‘zero deforestation’), but they both aim to reduce it significantly. HCS+ ensures no deforestation of HCV and HCS (as defined in this study) forests. Experience over the last 20 years has taught us that no amount of high-level declarations will protect forests on the ground unless and until local people and communities can see that their own economic interests and historic entitlements are better served through forests being set aside and protected for the long-term rather than cut down for short-term gain. We maintain that some level of responsible development, coupled with a strong role for both companies and local communities in the protection and management of set-aside forests is the best way to ensure the long-term protection of tropical forests in many countries.

4. The HCS+ methodology for carbon neutral development has the following benefits:

- It provides an additional mechanism to protect important forests beyond the constraint imposed by HCS+ thresholds.
- It facilitates the planning process by presenting for discussion various land development options in an objective way. Within given constraints, it allows flexibility in the allocation of land within a concession (or across concessions). In this way it can accommodate nationally and locally differing conditions and opportunities. It also challenges the concession holder to explore and benefit from production-relevant ecosystem services (such as carbon storage, water supply) derived from set-aside areas.
- It allows local communities to use set-asides for livelihood needs (such as hunting and harvesting of non-wood forest products), as long as carbon objectives are met.
- It makes the protection of all forest set-asides (HCS, HCV, riparian and others) a direct, binding, and ongoing responsibility of the concession holder. This provides a critical mechanism for ensuring the long-term protection of set-aside forests that currently does not exist. Currently, in many cases, HCV and HCS forests are identified but then not included within the concession boundary, meaning that the
developer takes no responsibility for preventing future deforestation or forest degradation in these areas. Communities themselves should play a central role in this management process in order to promote its effectiveness and provide them with further livelihood opportunities.

- HCS+ seeks to ensure that set-aside forests are effectively protected for the long-term. This effective protection of HCV and HCS forests (including peatlands) and the carbon neutrality of any conversion are the best guarantee that losses of forest values by deforestation and forest degradation are avoided over time. Thus, loss of some non-HCS forest to enable responsible development, may well result in much better overall forest conservation outcomes in the long run.

- It addresses the often neglected but significant issue of carbon in organic soils.

- It allows verification by independent parties.

5. **Achieving socio-economic benefits from oil palm development requires clarity over standards, and measurable criteria to assess outcomes. This approach should apply to existing human rights standards and to social contracts between companies and communities.**

To ensure that the positive impacts of oil palm development are strengthened, existing human rights standards need to be implemented more effectively, with better auditing and monitoring of adherence using measurable criteria. Companies need to develop transparent social contracts with communities which set out the roles and responsibilities of each including social infrastructure provision and employment creation by the company. The development of a tool to measure of various aspects of community welfare, in the form of the POWI (Palm Oil Welfare Index) will allow companies to assess outcomes in relation to their commitments. This will provide clear evidence of positive impacts and inform adaptation where necessary.

6. **Under carbon neutral development, the socio-economic implications of the need to protect large areas of set-aside forests need to be further explored.**

In addition to the socio-economic outcomes of the traditional oil palm operation, implementation of carbon neutral development, which creates a requirement to protect large areas of set-aside forests, also has considerable socio-economic implications. Although protection will bring additional costs, where development is carbon positive or generates biodiversity benefits there may be opportunities to build linkages to attract external resourcing and to achieve better overall outcomes.

There are also opportunities to boost local livelihoods as a result of community involvement in the management of set-aside, with the creation of ‘green’ employment - helping to magnify the positive impacts of existing operations.

7. **For large companies and associated smallholders, the following elements of HCS+ should be implemented immediately for new oil palm plantation developments:**

- Protect HCS forests, and HCS organic soils using the thresholds provided;
- Protect HCV forests and other riparian set-asides;
- Plan for carbon neutral development; and
- Robustly adhere to existing standards, and make stronger efforts to promote positive socio-economic outcomes and to measure and report effectiveness.

8. **For large companies and their attached smallholders, the full HCS+ methodology should be refined and fully implemented for new oil palm plantation developments within 3 years, and sooner if possible.**

To achieve this will require comprehensive field studies evaluating the HCS+ methodology in diverse forest systems in differing countries. These field studies should include several in Indonesia, one in Malaysia, and at least one in West/Central Africa. These trials should also explore mechanisms to bring independent smallholders within the HCS+ sustainable development framework. The learnings from the field studies should be incorporated into a ‘Toolkit’ for use by those developing new oil palm plantations.

9. **The conservation of HCS forests within new oil palm estates will inevitably increase pressure to convert forests in other places:**

This is a form of ‘leakage’31, and may also involve clearance to establish other less efficient oil-producing crops (such as rapeseed, sunflower or soybean) if the expansion of oil palm is curtailed. It is unlikely that all leakage can be avoided, but to help reduce leakage, it will be necessary to achieve wide-scale adoption of HCS+ and the effective protection of HCS+ forests that are set aside. Government support will be critical to achieving this. Making the protection of HCS+ forests a requirement for certification under the RSPO, and as a part of the purchasing policies of large companies, will also be important steps.

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31 Carbon leakage: When policy to reduce emissions in one area results in increased emissions elsewhere.
10. The HCS+ methodology focuses on concession-level development, but governmental planning of land-use at a larger spatial scale would produce greater overall benefits.

Landscape-level plans to identify areas suitable for sustainable oil palm development are required. This requires a more comprehensive approach to land use planning decisions (see Figures 5 and 6). It is much more than repeating land-use planning exercises in many concessions across the landscape. Rather it involves establishing conservation and development goals at much larger scales, and then allocating and managing land to achieve those objectives (for examples from around the world see Raison et al. 2001; Sayer and Campbell, 2004; Sayer and Maginnis, 2005; Bettinger et al. 2005; Frost et al. 2006). This approach will enable new plantation developments to be allocated to areas where environmental impact can be reduced, and where positive socio-economic benefits can be high.

Governments (or relevant state/provincial jurisdictions) must lead such planning, which will be guided by national priorities and goals, by working with all relevant stakeholders including business, NGOs and communities. A recent study by Austin et al. (2015) in Kalimantan demonstrated an application of such concepts. They showed that by relocating the development of new oil palm plantations to low carbon lands, GHG emissions could be reduced by 55-60% with very little impact on oil palm profitability. Amongst others, a significant pilot study testing the application of a landscape approach to improving the sustainability of oil palm is underway in northern Sumatra (CPI, IDH, Unilever, 2015).

Landscape planning would also help to deal with the vexed issue of degraded land. We currently have limited knowledge of the area of this land, or of its availability and suitability for growing oil palm at commercial levels of productivity.

11. The HCS+ method could be merged with the HCS Approach to provide clear and consistent guidance for companies and governments.

While the HCS Approach focuses more on conserving forests, and the HCS+ methodology focuses more on sustainable development, the methods and outcomes may be sufficiently complementary to allow convergence of the two. As discussed in Section 12, the HCS Approach and the HCS+ methodology are convergent in many respects, although the HCS Approach is cross-sectoral and HCS+ is only for oil palm. Planning is currently underway for joint trials of the two methodologies in diverse forest environments, and the experience and findings from that exercise will be valuable in facilitating further refinement that could hopefully lead to a single HCS methodology for future use by the oil palm sector.
References


United National Framework Convention on Climate Change (UNFCCC) decision (16/CMP.1).


Appendix 1: Further details on the application of remote-sensing to the mapping of above-ground carbon, and the mapping of organic soils

Mapping of Above-ground carbon

Our approach is designed to be:

- Compatible with existing standards (for example, REDD+, HCS Approach Toolkit)
- Able to take future developments into account that may supersede the current technology and techniques
- Cost-effective
- Built using open and transparent data-processing algorithms that can easily be audited by people not necessarily experts in the field
- Based on inherently conservative estimates of above-ground carbon, to ensure that the carbon stock in forests is overestimated rather than underestimated

Based on these principles, we propose the following technical parameters for LiDAR data collection and processing:

- Collection of discrete-return LiDAR data. Full-waveform data can be collected, however, it will be simplified to discrete-return data to allow forward compatibility with historic discrete-return data sets. Although full-waveform metrics are not yet used, by collecting full-waveform data it provides a degree of future-proofing against the likely eventuality of full-waveform data collection becoming routine.

To convert LiDAR vegetation height and structure metrics (at 1-m resolution) into above-ground carbon, a predictive statistical model should be developed at each site, using ground-based above-ground carbon estimates inferred from permanent forest plots. We recommend that plots should each be at least 0.25 ha in area. They should be distributed across the full range of forest types typical for the area (for example, old-growth forest and secondary/disturbed forest, dryland and swamp forests, riparian forests, scrubland, existing plantations). At least 20 such plots should be established to train the model used to infer above-ground carbon from LiDAR vegetation height and structure metrics. The model will be used to convert LiDAR vegetation and structure height metrics into above-ground carbon stock (in tC/ha). The statistical model itself should be based on the extraction of a shape-based metric from waveform data (for example, simulated waveform based on the histogram of the 3D LiDAR point cloud of the 50x50 m size at field plot location). We recommend the use of metrics such as the Centroid Height (CH) or the Quadratic Mean Canopy Height (QMCH) (Jubanski et al. 2013; Englhart et al. 2013; Asner et al. 2010).

Estimating above-ground carbon is based on an area approach. This does not rely on the ability to accurately extract individual trees, which is too complicated. above-ground carbon estimation is produced at a 50x50 m spatial resolution (0.25 ha). Field plots for LiDAR biomass model calibration should have the following specifications:

- The plots should be permanent, so that field work can be audited by independent assessors;
- In forest vegetation, square plots of 50x50 m (0.25 ha) offer a good balance between sampling intensity and ease of establishment;
- All trees of at least 10 cm of Diameter at Breast Height (DBH) will be mapped, tagged permanently and their DBH measured;
- In a 10x10m subplot, all trees of at least 2 cm DBH will be mapped, tagged and measured;
- The total height of at least 40 trees, stratified by DBH class, will be measured using accurate laser rangefinders;
- Wood density will be estimated from a measure of wood hardness, easily measured in the field using a Pilodyn instrument;
- Each plot should be carefully geo-located to at least 5m accuracy; and
- Plot measurements will be converted into above-ground carbon values using established sets of generic allometric models that convert DBH, total tree height and wood density into above-ground carbon for each tree (Chave et al. 2014).
Mapping of peatlands and other organic soils

Consulting studies in this HCS Science Study show that the accuracy of national soil and proxy maps is often good, as can be assessed by comparison with satellite imagery. Some soil maps, however, do not differentiate between organic or mineral hydromorphic soils or completely exclude ‘swamp’ soils. Furthermore, the age of the data (often >30 years) implies that organic soil occurrences may have disappeared by oxidation and flooding, or may have expanded by terrestrialisation of shallow lakes.

The use of remote sensing, in combination with available mapping material and verification on the ground may provide an optimal balance between comprehensiveness, accuracy and quantifiable uncertainties (Lawson et al. 2014). Because of frequent cloud cover, multiple remote sensing products should be used wherever possible. These also allow the simultaneous mapping of key features. From a remote sensing perspective, undisturbed tropical peatlands often have a high water table, a distinctive topography, a low-vegetation diversity, and a distinctive vegetation structure. Ombrotrophic peatlands are mostly dome-shaped, which can be detected by topographic data and are detectable using LiDAR-derived digital elevation models (DEM) or medium-resolution remote sensing products.

A DEM must be combined with data from peat corings to generate a spatially explicit map of minimal peat thickness. The DEM can be generated from the LiDAR survey. The spatial resolution should be in the range of 1-5 meters. The accuracy of the height measurements should be in the range of 5-20 cm. This requires dGPS measurements to rectify the LiDAR data set.

Coring locations must be selected using representative random sampling or systematic sampling, for example along transects that run perpendicular to the perimeter of the peatland. Sampling intervals must be closely spaced along the border of the peatland, but may range from 500 to 1,500 m depending on the size of the peatland, terrain accessibility, observed minimum peat thickness and the observed slope in subsequent peat assessments along the transect. If observed peat thickness is >50 cm for two subsequent corings along a transect, and if the DEM indicates a slope >0 in the same direction, then it is allowed to assume minimum peat thickness will not be underscored along the transect until the slope becomes <0.

Where conversion to oil palm plantation includes drainage, negative effects on adjacent, hydrologically connected areas must be avoided. Organic soils (most importantly peat soils) are sensitive to drainage and will lose large amounts of carbon when drained. Appropriate measures must be taken to ensure that drainage of the plantation site does not negatively affect carbon stocks in adjacent areas with organic soils, which are excluded from conversion. Measures may include the establishment of buffer zones or of impermeable dams. The effectiveness of measures must be demonstrated before drainage is undertaken. The VCS32 methodological framework VM0007 provides guidance on establishing and monitoring the hydrological measures.

32VCS: Verified Carbon Standard. For more on this, see www.v-c-s.org
Appendix 2: The contribution of forest ‘patches’ to biodiversity and other ecosystem services

Forest ‘patches’ are remnants of close-canopy forests within a converted landscape. In areas relevant to conversion into oil palm plantations, these patches are usually covered with previously logged or otherwise degraded forests. Such patches are critical for biodiversity conservation in tropical forests (Lucey et al. 2014). Both unlogged and degraded forests are essential in conservation biology (Berry et al. 2010). Essential descriptors of forest patches are their size (usually measured in ha), their shape, and their quality (how well these patches support wildlife). Species viability in patches depends on how large the patches are, and how well these patches are connected, with each other and with the main forest matrix, through corridors. It also depends on specific features of the patch (presence of fruiting trees as resources, availability of water, micrometeorology). Patch shape should also be considered carefully as edges have an adverse effect on species persistence (Laurance et al. 2011) and this effect is maximised in slender patches. Patch edge effects are usually largest within the first 100 m into the patch. In a 100 ha square patch, some 40% of the patch is thus influenced by edge effects. However, even narrow riparian zones facilitate the persistence of functionally important species (Gray et al. 2014). In addition to ensuring the persistence of species, patches render key ecosystem services. For instance, they contribute to filtering water in riparian zones with no adverse impact on the surrounding plantation (Gray and Lewis 2014).

New research in Sabah, Malaysia, shows that quite large patches (of ~100-200 ha) are required for the natural regeneration of tree species in the family Dipterocarpaceae (Loong et al in review), although planting of these species into smaller patches may be an option. Patches of at least 200 ha are needed for the persistence of ant species assemblages (Lucey et al. 2014), and patches as small as 120 ha contribute significantly to the persistence of butterfly species in the landscape (Benedick et al. 2006). However, unconnected small patches (less than 100 ha) can only maintain a drastically impoverished biodiversity (Edwards et al. 2010). Maintaining such small patches would only be sensible if they render key ecosystem services, including water filtering, wind reduction, and mitigation of erosion. The long-term viability of small patches is low because of edge effects, isolation, and vulnerability to environmental hazards. Thus the main focus for forest patch protection should be placed on patches >100 ha, which should be strategically located in the landscape. The long-term viability of small patches (<100 ha) is low because of edge effects (Wearn et al. 2012), and having too many small patches can render a new oil palm plantation non-viable.

HCS+ is conceptually aligned with the patch analysis method used in the HCS Approach’s Toolkit. Based on new evidence and research in oil palm-dominated landscapes, we confirm that 100 ha and above patches should be prioritised for protection. Imposing decision conditions based on patch connectivity is more delicate since effective connectivity depends on the studied group (i.e. it differs between ground dwelling insects, birds, and primates).

Reliable identification of the size, shape and location of forest patches is an essential challenge for forest conservation in tropical forests (Haddad et al. 2015) and in our HCS+ methodology. During preparation of the land development plan, decisions must be made about which patches should be retained (or aggregated), and where, as a mosaic among the proposed plantation. HCS+ proposes the use of LiDAR-derived high-resolution forest structure maps to delineate patches at metric scale. This approach is far more accurate than mapping based on optical medium-scale resolution imagery (such as Landsat), which is of little value for mapping such small forest remnants. It is also far more accurate than ground-based assessments. Based on this principle, we propose that the previously proposed HCS Forest Patch Analysis Decision Tree could be considerably simplified, as follows:

- Based on the metric-scale LiDAR above-ground carbon map, delineate patches of differing average above-ground carbon based initially on a minimum patch size of 10 ha.
- Measure basic metrics based on the map: patch connectivity, shape, canopy height, canopy complexity (heterogeneity of patch forest cover), mean above-ground carbon
- Perform a rapid biodiversity/habitat assessment on patches >100 ha (ground check)
- Use the above information to implement a simplified decision tree
Appendix 3: Summary of a brief desktop study on degraded land in Southeast Asia and Papua New Guinea

This analysis is restricted to Southeast Asia and is based on broad (coarse scale) information from the World Resources Institute (WRI) and FAO Statistics, and a few other supporting data and references.

Degraded land is defined as mainly grassland and scrub growing on either mineral or organic soils. Degraded peat land is not included in this analysis. FAO statistics on permanent meadows and pastures are assumed to represent degraded land.

Findings show that Indonesia had the largest areas of degraded land at 11 million ha followed by Thailand and Cambodia. The grasslands in Thailand and Cambodia are generally unsuitable for oil palm because they occur mainly in dry regions with unsuitable moisture regime. In Malaysia, the grasslands are mainly abandoned land, shifting cultivation land or small cattle farms. Again, they are generally unavailable for oil palm. In Papua New Guinea, the community owns most of the lands (>90%). An Incorporated Land Groups (ILG) process has to be properly and legally conducted before any land can be converted to oil palm plantations. This is usually a long drawn out and complicated process involving the community and government with investors coming in at a later stage.

Table A1: Estimated areas of permanent grassland in Southeast Asia and Papua New Guinea in 2012 (FAOSTAT, 2015).

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<th>Country</th>
<th>Area (ha)</th>
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<tbody>
<tr>
<td>Brunei Darussalam</td>
<td>3,400</td>
</tr>
<tr>
<td>Cambodia</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Indonesia</td>
<td>11,000,000</td>
</tr>
<tr>
<td>Laos</td>
<td>850,000</td>
</tr>
<tr>
<td>Malaysia</td>
<td>285,000</td>
</tr>
<tr>
<td>Myanmar</td>
<td>308,000</td>
</tr>
<tr>
<td>Philippines</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Singapore</td>
<td>-</td>
</tr>
<tr>
<td>Thailand</td>
<td>800,000</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>150,000</td>
</tr>
<tr>
<td>Vietnam</td>
<td>642,000</td>
</tr>
<tr>
<td>Total</td>
<td>17,038,400</td>
</tr>
</tbody>
</table>

Papua New Guinea 190,000

Note: Areas in Papua New Guinea appear to be underestimated

In Indonesia, more comprehensive data on degraded land are available for Kalimantan particularly from WRI. The degraded land shown in yellow in Figure A1 includes bare land. There are 6.6 million ha of degraded land in Kalimantan and they are distributed throughout the region. Most areas are in East Kalimantan because those in West and South Kalimantan have been integrated or converted to agricultural lands or plantation crops.

Overlaying the oil palm concession map (the map also seems to include some timber and logging concessions) on the degraded land shows that 1.6 million ha of degraded land occurs within the oil palm concession (Figure A2). This accounts for only 25% of the degraded land in Kalimantan assuming that the oil palm concession has an APL permit for agricultural development (this may not be correct since the maps show substantial overlap with timber and logging concessions). The balance is currently not available for oil palm. This finding agrees with Lambin and Meyfroidt (2011) who assumed that globally only 20% of unused, productive land was available for cultivation. They attributed this to institutional constraints, such as land tenure, political conflicts and traditional rights of land access, and biophysical constraints, such as accessibility, risks of natural hazard and ecological corridors.

We have not examined the suitability of the degraded land within the concession for oil palm development. Visually, part of the degraded land is probably on deep peat (Figure A3) which renders it unsuitable for oil palm development. Other possible limitations are elevation, terrain, shallow and fragile soils, and institutional constraints such as shifting cultivation (native lands) and transmigration lands.

For example, in Central Kalimantan where the transmigration projects totalled approximately 825,000 ha (Figure A4), a large proportion are on degraded land.

The potential area of degraded land suitable for oil palm in Kalimantan may be approximately 1.6 million ha or 25% of the total degraded land. This gross estimate is likely to be reduced when other factors affecting sustainable development are considered, leaving little room for socio-economic development.

The other 5 million ha of degraded land which lies outside the oil palm concession area will require further evaluation including land status (for example, overlapping land titles), land tenure, accessibility, biophysical properties (Paramananthan et al. 2000) and other factors in order to ascertain their possible availability for oil palm.
Figure A1: Simplified land use cover map of Kalimantan (Source: WRI).

Figure A2: Map showing the degraded lands within the oil palm concession area in Kalimantan.
Figure A3: Distribution of peat land in Kalimantan (Source: WRI).

Figure A4: New and older transmigration sites in Central Kalimantan (Redrawn from Potter, 2012).
Appendix 4: Existing social standards for sustainable palm oil

There are more than thirty existing standards addressing socio-economic aspects of oil palm development. They relate to participatory processes for establishing set asides and social infrastructure for local communities, human rights standards for labour, and standards for smallholders. The following tables group these standards thematically under these three aspects.

**Table A2:** Existing human rights standards for establishing set asides and social infrastructure for local communities through participatory process.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Issued By</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARTICIPATORY PLANNING PROCESS TO IDENTIFY SET-ASIDES</td>
<td>HCV (under RSPO principle 5)</td>
<td>HCV5: Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples (for livelihoods, health, nutrition, water, etc...), identified through engagement with these communities or indigenous peoples.</td>
</tr>
<tr>
<td></td>
<td>HCV (under RSPO principle 5)</td>
<td>HCV 6: Sites, resources, habitats and landscapes of global or national cultural, archaeological or historical significance, and/or of critical cultural, ecological, economic or religious/sacred importance for the traditional cultures of local communities or indigenous peoples, identified through engagement with these local communities or indigenous peoples.</td>
</tr>
</tbody>
</table>
| | RSPO NEXT | HR1.2: The company shall demonstrate it has taken negative indirect secondary impacts into consideration and has, for example, refrained from developing areas that will be used by the communities for current and future subsistence and other land needs.  
• The initial planning shall cover at least the first cycle of the oil palm development. Further consultations with affected stakeholders and identified relevant third parties shall be carried out to review the plans, before and throughout development phases. Planned land allocation to various activities shall be shared during such consultations. |
<p>| | RSPO | 6.1: Aspects of plantation and mill management that have social impacts, including replanting, are identified in a participatory way, and plans to mitigate the negative impacts and promote the positive ones are made, implemented and monitored, to demonstrate continual improvement. |
| | RSPO | 6.2: There are open and transparent methods for communication and consultation between growers and/or millers, local communities and other affected or interested parties. |
| | RSPO | 6.13: Growers and millers respect human rights. |
| | RSPO | 7.1: A comprehensive and participatory independent social and environmental impact assessment is undertaken prior to establishing new plantings or operations, or expanding existing ones, and the results incorporated into planning, management and operations. |</p>
<table>
<thead>
<tr>
<th>Topic</th>
<th>Issued By</th>
<th>Standard</th>
</tr>
</thead>
</table>
|       | RSPO NEXT | **HR1.1:** The company shall use independent and participatory SEIA to develop plans to mitigate the negative and promote the positive indirect or secondary impacts of the plantation development.  
- Negative indirect/secondary impacts can be (without being limited to): food security issues for local communities (including communities not in the immediate vicinity of the project), increased land pressure on natural/protected habitats and land conflicts caused by reduced land availability. |
|       | POIG*     | **2.4.1:** Social impact assessments and plans for the avoidance or mitigation of impacts shall incorporate the issues of potential human rights violations, social conflicts and land grabbing. |
|       | POIG*     | **2.2.1:** Food security for workers, smallholders, and indigenous and local communities on existing plantations is assessed and included in a social management plan. The scope of the food security assessment shall include additional impacts that oil palm production operations may have on relevant requirements including land, water, labour and infrastructure as well as substitutability between income generation for food purchase and subsistence food production if workers, smallholders and affected communities.  
**2.2.2:** After March 2014, a minimum of 0.5 ha per person (in a family unit) shall be identified via participatory mapping, and enclaves for meeting food security needs.  
**2.2.3:** Measures designed to maintain or enhance local food security shall be included in participatory planning, including transparency in any land allocation process.  
**2.2.4:** Evidence that measures identified in assessments and planning are being implemented and are effective. |
| **REPRESENTATION FOR LOCAL COMMUNITIES** | POIG* | **2.1.1:** Resourced access to independent expert advice shall be offered at each stage of an FPIC or conflict resolution process to affected communities.  
**2.1.2:**Processes of consultation and negotiation shall not be constrained by local legal frameworks.  
**2.1.3:** The acquisition or replanting of existing plantations shall include measures to ensure redress for any issues arising from inadequate FPIC processes when those plantations were established.  
**2.1.4:** If indicator 2.1.3 is applicable, participatory surveys will identify HCV's 4, 5 and/or 6 that existed before areas were converted to oil palm.  
**2.1.5:** Land shall not be acquired through expropriations in the national interest (eminent domain). |
|       | RSPO      | **6.4:** Any negotiations concerning compensation for loss of legal, customary or user rights are dealt with through a documented system that enables indigenous peoples, local communities and other stakeholders to express their views through their own representative institutions. |
| **CONSENT FROM LOCAL COMMUNITIES** | RSPO NEXT | **HR1.3:** The company shall respect the decision by some communities to refuse, before it is started, the planned development. Recognising that social values are dynamic, and that communities are free to make their own choices, the company shall ensure that the process of consultation and of planning is adaptive and allows for yearly (or more frequent, as needed) consultations during the development of the project.  
**HR4.1:** Growers and millers shall adhere to the RSPO approved FPIC guidance. Company policy shall prohibit intimidation and harassment. |
<table>
<thead>
<tr>
<th>Topic</th>
<th>Issued By</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RSPO NEXT</td>
<td><strong>HR4.2:</strong> Companies shall respect land rights and FPIC even if the State fails in its duty to protect land rights, notably by invoking the national interest (also known as ‘eminent domain’). Plantation operations shall cease on land planted beyond the legally determined area and there shall be specific plans in place to address such issues for the full supply base.</td>
</tr>
<tr>
<td><strong>PROCESS FOR GRIEVANCES</strong></td>
<td>RSPO NEXT</td>
<td><strong>HR3.1:</strong> Communication and consultation procedures, including FPIC and dispute resolution mechanisms for individual cases, shall be established in consensual agreement with affected stakeholders, local communities and/or interested parties, with particular assurance that vulnerable, minority and gender groups shall be consulted.</td>
</tr>
<tr>
<td></td>
<td>RSPO</td>
<td><strong>6.3:</strong> There is a mutually agreed and documented system for dealing with complaints and grievances, which is implemented and accepted by all affected parties.</td>
</tr>
<tr>
<td></td>
<td>RSPO NEXT</td>
<td><strong>HR4.3:</strong> Where there is conflict over land use the grower shall through their mechanism to resolve conflicts show evidence that the necessary action to resolve the conflict with relevant parties has been or is being taken. Where operations overlap with other rights holders the company shall resolve the issue with the appropriate authority consistent with RSPO P&amp;Cs.</td>
</tr>
<tr>
<td></td>
<td>POIG*</td>
<td><strong>2.3.1:</strong> The mutually agreed and documented system for dealing with complaints and grievances shall be accessible to all affected parties.</td>
</tr>
<tr>
<td></td>
<td>POIG*</td>
<td><strong>2.3.2:</strong> The system will provide a clear and known procedure with an indicative time frame for each stage.</td>
</tr>
<tr>
<td></td>
<td>POIG*</td>
<td><strong>2.3.3:</strong> The system will keep parties to a grievance informed of its progress.</td>
</tr>
<tr>
<td></td>
<td>POIG*</td>
<td><strong>2.3.4:</strong> The system shall include the options of a) access to independent legal and technical advice; b) support from representatives of local communities’ own choosing, and c) third party mediation.</td>
</tr>
<tr>
<td></td>
<td>POIG*</td>
<td><strong>2.3.5:</strong> Evidence that where conflicts have arisen the conflict resolution mechanism is being used and outcomes are considered mutually agreed including by affected parties.</td>
</tr>
<tr>
<td></td>
<td>POIG*</td>
<td><strong>2.3.6:</strong> Evidence that outcomes and remedies resulting from use of the mechanism are compatible with internationally recognised human rights.</td>
</tr>
<tr>
<td><strong>SOCIAL INFRASTRUCTURE</strong></td>
<td>RSPO</td>
<td><strong>6.11:</strong> Growers and millers contribute to local sustainable development where appropriate.</td>
</tr>
</tbody>
</table>
### Part 2: Synthesis Report

**HCS+: A new pathway to sustainable oil palm development**

#### High Carbon Stock Science Study

- **Topic**: RSPO NEXT
- **Standard**: HR1.4: Positive social impacts of plantation development shall be actively promoted, including but not limited to:
  - Where candidates for employment are of equal merit, preference shall be given to hiring from local communities.
  - Understanding and supporting existing alternative livelihoods and ensuring they are not threatened or reduced.
  - Provision of health and educational facilities where these are lacking or not available within accessible distance.

- **POIG***: 2.4.2: Social impact assessments and plans for the avoidance or mitigation of impacts shall address key equity issues, including housing, healthcare, education, and empowerment of women.

* indicators in public consultation until Sept 4, 2015

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**Table A3: Existing human rights standards on labour.**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Issued By</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAIR WAGES</strong></td>
<td>RSPO</td>
<td>6.5: Pay and conditions for employees and for contract workers always meet at least legal or industry minimum standards and are sufficient to provide decent living wages.</td>
</tr>
<tr>
<td></td>
<td>POIG*</td>
<td>Remuneration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5.1: Wages are paid regularly, on time, directly to the worker and in legal tender or cheque.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5.2: Wage advances, loans and deductions are strictly monitored to ensure they are legal and to prevent deception, fraud and debt bondage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Working Hours and Leave</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5.3: Records show that hours of work do not exceed the maximum allowed by local law, regulation or collective agreement. The normal work week, not including overtime, does not exceed 48 hours, and workers are entitled to at least one day off in 6 consecutive days. Workers report that all overtime is voluntary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5.4: All workers are provided legally mandated public holidays and periods of leave consistent with applicable law, including paid annual, parental, compassionate and sick leave.</td>
</tr>
<tr>
<td><strong>FREEDOM OF ASSOCIATION</strong></td>
<td>RSPO</td>
<td>6.6: The employer respects the rights of all personnel to form and join trade unions of their choice and to bargain collectively. Where the right to freedom of association and collective bargaining are restricted under law, the employer facilitates parallel means of independent and free association and bargaining for all such personnel.</td>
</tr>
<tr>
<td></td>
<td>RSPO NEXT</td>
<td>HR5.1: The company shall document a process of negotiation with the workforce or duly selected representatives of the workforce to establish and implement a mutually agreed upon total compensation package that represents a ‘decent living wage’ with a minimum of at least the legal minimum wage (regardless of hourly or piece rate payments).</td>
</tr>
<tr>
<td>Topic</td>
<td>Issued By</td>
<td>Standard</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>RSPO NEXT</td>
<td>HR5.2: There shall be no evidence of employees, including migrant, transmigrant workers and/or contracted workers being prevented from forming or joining associations and/or participating in collective bargaining, within the limits of national legislation.</td>
</tr>
<tr>
<td></td>
<td>RSPO NEXT</td>
<td>HR5.3: There shall be evidence that workers and employers understand workers rights to collective bargaining and freedom of association.</td>
</tr>
<tr>
<td>CHILD AND FORCED LABOR</td>
<td>RSPO</td>
<td>6.7: Children are not employed or exploited.</td>
</tr>
<tr>
<td></td>
<td>RSPO NEXT</td>
<td>HR5.4: No hazardous work (as defined by the ILO) shall be carried out by anyone under the age of 18.</td>
</tr>
<tr>
<td></td>
<td>RSPO NEXT</td>
<td>HR5.5: There shall be evidence of initiatives to maximise education and career opportunities for the children of plantation and mill staff, including but not limited to:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Provision of educational resources (e.g. textbooks, stationery),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Outreach programmes on career opportunities within and outside the plantation, and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. The provision of apprenticeship opportunities for school leavers.</td>
</tr>
<tr>
<td></td>
<td>POIG*</td>
<td>2.5.5: A clear policy and compliance system is in place that prohibits child labour and sets the minimum age for employment consistent with applicable law.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5.6: Young workers legally permitted to work but subject to compulsory education laws only work outside school hours.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5.7: The company maintains an up-to-date list of hazardous activities and functions in the workplace that are prohibited for young workers consistent with or exceeding national regulation, where applicable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forced or trafficked labour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5.8: No fees or costs are charged to workers, directly or indirectly, for recruitment or employment services by recruitment agencies, private employment agencies or the employer. Where is it discovered that fees have been charged, workers are reimbursed the total amount paid.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5.9: The retention of passports, other government-issued identification and any personal valuables by the employer or third party recruitment or employment agency is strictly prohibited in policy and monitored in practice.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5.10: Growers and millers conduct a risk assessment of their FFB supply chain to identify and take steps to address risk of forced labour, human trafficking and child labour.</td>
</tr>
<tr>
<td></td>
<td>RSPO</td>
<td>6.12: No forms of forced or trafficked labour are used.</td>
</tr>
</tbody>
</table>
Part 2: Synthesis Report

HCS+: A new pathway to sustainable oil palm development

<table>
<thead>
<tr>
<th>Topic</th>
<th>Issued By</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISCRIMINATION AND HARASSMENT</td>
<td>RSPO</td>
<td>6.8: Any form of discrimination based on race, caste, national origin, religion, disability, gender, sexual orientation, union membership, political affiliation, or age, is prohibited.</td>
</tr>
<tr>
<td></td>
<td>RSPO</td>
<td>6.9: There is no harassment or abuse in the work place, and reproductive rights are protected.</td>
</tr>
<tr>
<td></td>
<td>RSPO NEXT</td>
<td>HR5.6: A gender committee shall be established specifically to address areas of concern to women. (Management representatives responsible for communication with the gender committee shall be female)</td>
</tr>
<tr>
<td></td>
<td>RSPO NEXT</td>
<td>HR5.7: All complaints/grievances of harassment or abuse shall be documented and responses &amp; actions monitored. There shall be time bound targets for reducing the number of harassment or abuse cases.</td>
</tr>
</tbody>
</table>

* indicators in public consultation until Sept 4, 2015

Table A4: Existing human rights standards on smallholders.

<table>
<thead>
<tr>
<th>Issued by</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSPO</td>
<td>6.10: Growers and millers deal fairly and transparently with smallholders and other local businesses.</td>
</tr>
<tr>
<td>RSPO NEXT</td>
<td>HR2.1: Growers and millers shall have and implement a plan to ensure that the smallholder supply base meets RSPO requirements.</td>
</tr>
<tr>
<td></td>
<td>Plans shall consider technical, financial and training support for practices relevant to all other P&amp;Cs, particularly soil management practices, chemical and fertiliser use and storage, use of seedlings, the identification, management and monitoring of HCV, HCS and peatland, the reduction of emissions, the resolution of land conflict, the promotion of staff/workers welfare and sustainable development.</td>
</tr>
<tr>
<td>POIG*</td>
<td>2.6.1: A smallholder support programme shall be documented and monitored, which includes: a) Measures to increase the productivity of smallholders to a comparable benchmark of productivity for the region, and a target of reaching the same productivity level as company estates; b) Support relating to financial management and budgeting and c) Support relating to logistics, FFB processing and improved market access.</td>
</tr>
<tr>
<td></td>
<td>2.6.2: Progress in implementation of the smallholder support programme shall be included in public reporting.</td>
</tr>
<tr>
<td></td>
<td>2.6.3: Report on percentage of schemed smallholders, percentage of independent smallholders and percentage RSPO certified of each.</td>
</tr>
<tr>
<td></td>
<td>2.6.4: Develop a group certification plan for independent smallholder identified in the supply base of each mill within three years of the mill obtaining its own certificate and support a group certification system.</td>
</tr>
</tbody>
</table>

* indicators in public consultation until Sept 4, 2015
The following consulting studies have been used to support the HCS Science Study. The full Reports are included in the USB drive attached to this report.


Part 3: Gabon Case Study
The HCS+ methodology tested on the ground
Executive Summary

1. The overall goal of this case study was to assess the feasibility of the HCS+ methodology in real world conditions. We evaluated elements of the HCS+ methodology by applying them to three diverse concessions being developed for oil palm by Olam in Gabon. Our evaluation was facilitated by a strong existing data base, including complete coverage of air-borne LiDAR, documentation from Olam, and a brief field visit by the authors of this report. Our case study tested the feasibility of the HCS+ methodology in some key areas:

- Delineating HCS forests and soils;
- Estimating the carbon balance of the concessions when applying the principle of carbon neutral development that includes the protection of set-aside HCV and HCS forests; and
- Reviewing, albeit briefly, Olam’s socio-economic approach and comparing it to the recommendations of the HCS+ socio-economic methodology.

Our study did not cover the integration of key inputs needed to make land development decisions; and we did not evaluate Olam’s operations in Gabon against HCS+ recommendations.

2. The Gabon case study evaluated the applicability of the HCS+ method in highly-forested landscapes with low human population densities. Gabon is representative of other parts of Central and West Africa with high forest cover and is less representative of the more fragmented landscapes of Southeast Asia. Moreover, the human population density of Gabon is low compared with Southeast Asia. This low density makes it easier for companies to engage with local communities. Additional case studies of the HCS+ methodology are needed in a range of ecological and socio-economic conditions.

3. The HCS+ methodology to analyse LiDAR data proved feasible and reliable for this case study. LiDAR was successfully used in combination with ground-based biomass measurements to prepare a map of above-ground carbon for two of the concessions, which was then used to delineate High Carbon Stock (HCS) forests. The case study did not provide an adequate opportunity to test the methodology for identifying high carbon soils, because such soils were probably not present in the area developed for oil palm. Olam did not employ strict quantitative HCS thresholds to guide their planning decisions, but did avoid conversion of much HCS forest based on their field survey of the locations of such forests.

4. The case study highlights the challenges of conservation of High Carbon Stock forests in highly forested landscapes. Application of the HCS+ threshold for above ground carbon (75 tonnes of carbon per hectare) would strongly constrain the area of land available for development in two of the concessions examined. Application of the HCS Approach (where the above ground carbon threshold is equivalent to about 35 tonnes per hectare) would have been much more restrictive. The application of HCS+ thresholds to forest lands identified by the government of Gabon as potentially convertible to agriculture in their national land use plan requires further consideration. Gabon has a very high cover of dense forest, and the national plan considers the balance between the needs for conservation and development.

5. The HCS+ method for planning for carbon neutral development proved practicable and was successfully demonstrated in two concessions. The case study showed that when large areas of High Conservation Value (HCV) and HCS set-asides are protected, development will be highly carbon positive. Likewise, development on low carbon lands such as the Lot 3, which is dominated by savannah, can also be highly carbon positive. We recommend that a conservative value, based on a review of global literature, should be used for the rate of carbon accumulation in protected set-asides when planning for carbon neutral development, so as to avoid the risk of a short-fall in carbon stocks when these are assessed later in the life of the plantation. Where robust regional values, based on a synthesis of measurements across representative sites, are available these can be used. Varying the minimum size of forest patches to be conserved did not have a major effect on the area of forest that could be converted, but it does have major implications for plantation layout and for the long-term viability of protected patches. Further consideration of this issue is recommended.

6. Olam’s approach towards local communities is largely in line with the HCS+ socio-economic methodology and suggests that the method is feasible in practice. Based on a review of existing internal documents and a brief visit to the field, we found that Olam’s approach to achieving positive socio-economic outcomes from oil palm development for local communities includes working closely with local communities before and after conversion, establishing set-asides for livelihood needs, adhering to FPIC principles, and providing social infrastructure. The approach appears to be comprehensive and is broadly consistent with the HCS+ methodology. The implementation of a more formal and comprehensive monitoring of socio-economic impacts based on measurable criteria as recommended by the HCS+ socio-economic method would be beneficial for assessing whether existing obligations have been met and providing a basis for adaptive management where required.

7. In summary, the HCS+ remote sensing and socio-economic method appear practicable for this case study from a technical perspective. We did not have information to evaluate the costs of implementing the methodology. Additional case studies require analysis of cost effective approaches to achieve the objectives of the HCS+ methodology.
Section 1: Introduction

The HCS Science Study was commissioned by the signatories to the Sustainable Palm Oil Manifesto. The Manifesto is designed to deepen sustainability commitments on various aspects of palm oil production, with a focus on defining and safeguarding High Carbon Stock forests. The study proposes a new pathway, outlined in the HCS+ methodology, to support the sustainable development of oil palm plantations (Part 2 of the larger report).

There is wide agreement that High Carbon Stock (HCS) forests should be protected. These forests store large amounts of carbon that are released by conversion - accelerating climate change. Just as important, these forests provide livelihoods for local people. They are also home to a wide variety of animal and plant species - many of them endangered - and provide invaluable ecosystem services to local communities, and more widely.

Existing policies to protect HCS forests (often summed up under the label ‘No Deforestation’) have laudable aims. But they are proving very difficult to put into action in the real world. A major reason for this is that the governments ultimately have to implement the policies, and also value the socio-economic benefits of development as a way of alleviating poverty. They see agricultural expansion into tropical forests as a pathway to development. Some see the ‘No Deforestation’ approach as running counter to development goals.

The HCS+ methodology offers the possibility of delivering oil palm development that:

- Ensures carbon neutrality and contributes to protecting essential non-carbon forest values in actively managed set-aside forests;

- Protects human rights and improves welfare; and

- Is economically viable and acceptable to key stakeholders including governments, local communities and companies undertaking new developments.

HCS+ makes it possible to achieve these goals while also allowing the carefully planned conversion of some forest that contains less carbon and other forest values to oil palm.

As part of the development and refinement of HCS+ methodology, several of the new concepts were evaluated using three diverse oil palm concessions in Gabon. This HCS+ Case Study was conducted in collaboration with Olam Palm Gabon, which is working in joint venture with the Government of Gabon to develop new oil palm estates. It is important to note that the HCS+ methodology was applied retrospectively - Olam had already completed the plantation layout, New Planting Procedures of the Roundtable on Sustainable Palm Oil (RSPO), and all or part of the development of each concession prior to this study. We used Olam’s data to apply various components of the HCS+ methodology, and also compared the outcomes of the HCS+ methodology with those of Olam’s land-use decisions.
Section 2: Brief Description of the HCS+ Methodology, and the Key Elements Evaluated in the Case Study

The HCS+ methodology, which is described in detail in Part 2 of the larger report, places a strong emphasis on constraining carbon emissions within a framework that protects important forests. The ‘HCS’ in the name relates to the focus on carbon emissions - which impact adversely on global climate; the ‘+’ indicates that there will be opportunities for improved livelihoods by allowing some level of responsible conversion of non-HCS forest to oil palm.

The HCS+ methodology provides criteria (expressed via carbon thresholds) to identify forests and soils that should not be converted to oil palm, thereby safeguarding ecosystem services. Areas that do not meet these criteria may be converted. However, HCS+ requires that carbon losses from conversion are balanced by carbon gains in protected forests and the oil palm plantation, to achieve carbon neutrality across the concession as a whole.

As explained in Part 2 of the larger report, HCS+ also provides a process for the integration of HCS1 considerations with HCV2, FPIC3 and other important inputs to support the sustainable development of new oil palm plantations. Integration is achieved using a comprehensive multi-stakeholder process to determine the acceptable location and magnitude of future land conversion to oil palm (Figure 1).

Thus HCS+ covers more than just carbon and carbon emissions caused by forest conversion. However, in the HCS+ methodology, reliable estimates of carbon stocks and their change are critical, because these are used to define High Carbon Stock forests and to underpin planning for carbon neutral development.

HCS+ also sets out three requirements or ‘Pillars’ needed for oil palm development to be considered sustainable. These three Pillars must be constructed independently, without trade-offs between them. The three Pillars are:

Pillar 1: Land conversion for oil palm must maintain critical ecosystem services.

Tropical forests provide multiple ecosystem services. At the global scale, tropical forests and soils help regulate climate. When land is converted to oil palm plantations, carbon stored in biomass and in soils is released to the atmosphere as a greenhouse gas. Tropical forests also harbour more biodiversity than any other terrestrial ecosystem. At the local scale, tropical forests produce many other benefits. These benefits include protection of watersheds from erosion, and habitat for plants and animals that contribute to food security and livelihoods for local communities.

Pillar 2: Oil palm development must ensure socio-economic benefits for local communities.

Carefully planned and executed oil palm development can benefit local communities by providing access to employment and services. It can also contribute to economic development at the regional and national scale. Conversely, inappropriately planned and executed oil palm development can violate human rights by displacing local people without compensation or consent, and by creating food insecurity in local communities as a result of severing access to traditional food sources. The HCS+ methodology allows Pillars 1 and 2 to be achieved simultaneously - and without net carbon emissions - through carefully planned and executed oil palm development.

An important way that companies can contribute to local welfare is by supporting social infrastructure, such as education, health facilities and electricity, where these are not fully provided by governments. This support can be part of a mutually-agreed social contract between companies and local communities.

Pillar 3: Oil palm development must be economically viable.

The economic viability of oil palm concessions is highly dependent on maintaining the lowest possible production costs and on obtaining high yields. Only if both are achieved can reasonable revenues and profits be produced. Therefore the HCS+ methodology proposed for Pillars 1 and 2 must be practical and cost-effective. It must, for example, take account of the increased production costs (resulting from, for example, additional management or lower yields) that may result from shifting land conversion to locations with poor soils, or to degraded land, or to areas with seasonally dry climates, and actively managing forest set-asides to accumulate carbon.

Adherence to the HCS+ methodology has the potential to produce many economic and social benefits as described in the main report of the HCS Science Study.
The following are the key steps in implementing the HCS+ methodology. They are summarised in Figure 1.

1. Map vegetation and land use in the concession and in adjacent areas using high-resolution optical remote sensing such as RapidEye. Information for the surrounding forests (such as the continuity of forest cover, location of settlements) provides important context to guide decisions within the concession boundary. In addition, mapping includes socio-economic characteristics such as land tenure and metrics of human-wellbeing.

These aspects are covered in Sections 4 and 7 of this report.

2. Map estimated above-ground carbon within the entire concession using Light Detection and Ranging (LiDAR) technology that has been appropriately calibrated using biomass estimates made on large plots (of at least 0.25 ha) across the range of biomass likely to occur in the concession. The aboveground carbon map should have a resolution of 0.25 ha.

These aspects are described in Section 5.

3. Map areas of the concession where organic soils exceed 15 cm in depth using a combination of terrain information (from LiDAR), vegetation surrogates, and targeted ground survey. Presence of these soils will render a unit of land as HCS, irrespective of the vegetation present.

These aspects are briefly described in Section 5.

4. Apply the HCS+ thresholds for above-ground carbon (75t/ha) and soil carbon (organic soil > 15 cm in depth, equivalent to 75 tC/ha) to define each spatial unit as either HCS or non-HCS land. The spatial unit (aggregation) used for further spatial analysis is 10 ha.

Details are provided in Section 6.

5. Land identified as having high conservation value (HCV) is set aside irrespective of its carbon stock. This land would include, for example, areas of cultural value, riparian areas and animal corridors. The principle of Free, Prior, Informed Consent (FPIC) is also taken into account. The FPIC process might well identify further land to be set aside to meet community needs.

HCV assessments were conducted by independent experts commissioned by Olam whilst FPIC processes were led by Olam. These were reviewed but not critically re-evaluated as part of this Case Study.

6. Identify forest patches that should be conserved, and those that could be converted to oil palm. Patches of forest smaller than 30 ha in size are unlikely to have carbon or conservation viability in the long-term, even if they are identified as HCS at the time of assessment. In reality much larger patches, of the order of hundreds of hectares, are likely to be needed for long-term viability in Southeast Asian rainforests (Lucey et al. 2015). The HCS+ methodology allows some exchange of patches up to 10 ha, whether above or below the HCS threshold (outside HCV and FPIC areas), to reduce fragmentation and facilitate the practicalities of laying out new oil palm plantations. This means that some small HCS forest patches may be converted and some non-HCS patches protected. By protecting all patches of HCS forest > 10 ha in size, the HCS+ methodology is precautionary.

This analysis is described in Section 6.

7. Estimate and map the carbon emissions that would result from conversion of land potentially available for new oil palm plantations. Then undertake spatial planning to achieve carbon neutral (or carbon positive) development at the level of the concession. This is achieved if the total area (including set-asides) has a zero or positive carbon balance. There are multiple options for achieving carbon neutral development, and this provides planning flexibility. The carbon losses and gains must be estimated robustly and conservatively before conversion, monitored throughout the rotation period (to allow for adaptive management), and verified at the end of the rotation period.

Evaluation of the carbon neutral approach is described in Section 6.

8. Provide HCS+ outputs as input into multi-stakeholder negotiations leading to an agreed land development plan. The key HCS+ outputs are:

- Maps that put the concessions into a landscape context, and includes: land cover and land-use, hydrological catchments, adjacent conservation forests, HCV areas, agriculture, and road and settlement infrastructure. The spatial extent of this map should be determined by political, administrative and ecological (for example, catchment) boundaries. The map is derived from high-resolution satellite imagery, in conjunction with ancillary GIS data.

- Maps of potential land available for development after HCS+, HCV and FPIC constraints have been applied as described above. Maps for different options to achieve carbon neutral development, and options for aggregation and retention of forest patches can also be provided to inform planning decisions.

- Guiding principles on how to avoid negative impacts of development, and on how to boost positive socio-economic benefits at the local and regional scale.

The various maps and other outputs produced are integrated - this is discussed in Section 8.

9. Apply multi-stakeholder processes to produce agreed land use decisions and management plans. This process should be facilitated either by government agencies, or by an independent facilitator to help ensure fair and robust outcomes.

This step was not part of the case study. Olam used their own process to plan development of each concession.

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KEY STEPS IN IMPLEMENTING A HCS+ METHODOLOGY

<table>
<thead>
<tr>
<th>SOCIO-ECONOMIC CONSIDERATIONS</th>
<th>CARBON CONSIDERATIONS</th>
<th>BIODIVERSITY CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiate Free, Prior and Informed Consent (FPIC) processes</td>
<td>Map estimated biomass carbon distribution and soil types across the concession based on remote sensing and field surveys</td>
<td>Map HCV and HCS forest areas</td>
</tr>
<tr>
<td>Map land use and areas used for local livelihoods using participatory mapping within and adjacent to concession</td>
<td>Apply HCS thresholds and rules to define patches for protection or development</td>
<td></td>
</tr>
<tr>
<td>Multi-stakeholder process to identify needs for social infrastructure/development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-stakeholder process to identify areas needed for food security and other livelihoods of local communities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Map areas of land **not available for conversion** based on: carbon thresholds, HCV, and FPIC that determines local community use

Estimate and **map potential carbon fluxes (soil + biomass)** that would result from oil palm conversion in available land

Map options for achieving **carbon neutral development**

Provide maps and plans for improved welfare as input to FPIC and multi-stakeholder negotiations

**Agreed land development plan**

**Implementation plan**
- Clear goals for socio-economic and environment considerations
- Detailed procedures for how to achieve these goals

**Figure 1:** Key steps in implementing HCS+ to support the sustainable development of new oil palm plantations. These are described in detail in Part 2 of the larger Report.
Section 3: Description of the Three New Oil Palm Estates Being Developed by Olam in Gabon

Agricultural development in Gabon

Gabon is a sovereign state on the west coast of Central Africa. It became independent from France in 1960. It has an area of nearly 270,000 square kilometres and its population is estimated at 1.6 million people.

Low population density, abundant petroleum, and foreign private investment have made Gabon one of the most prosperous countries in Sub-Saharan Africa, with the 4th highest Human Development Index and the third highest Gross Domestic Product (GDP) per capita (after Equatorial Guinea and Botswana) in the region. About 11% of Gabon’s land area is designated as National Parks.

Gabon’s dependence on fossil fuel exports, comprising about 50% of GDP, has led to underinvestment in agriculture, and 60% of the food consumed in Gabon is imported. Gabon’s National Strategic Plan calls for rapid agricultural development to diversify its economy, reduce its food imports, increase food security, reduce rural poverty and create job opportunities, especially for the 26% of the population who are unemployed.

In 2010, Olam entered into a joint venture with the Republic of Gabon (60:40 share respectively), to develop sustainable oil palm plantations. Olam Palm Gabon (subsequently referred to as Olam) now manages a total area of 110,983 ha, of which more than 50% has been set aside to protect HCV areas, riparian buffers and wetlands. As of October 2015, Olam has planted nearly 21,000 ha of high-yielding palm varieties, provided jobs for over 4,000 people in rural areas, and built schools, dispensaries, housing and access roads for local villagers.

Olam is committed to obtaining RSPO certification for all its plantations, to avoiding conversion of High Conservation Value forests, HCS forests or peatlands, to obtaining Free Prior and Informed Consent for its plantations, and to improving rural livelihoods.

Gabon’s Climate Action Plan and National Land Use Plan

Under its April 2015 Climate Action Plan for the UNFCCC, Gabon committed to reducing its greenhouse gas emissions by 50% in 2025 relative to 2000. Achieving this reduction depends on the rational use of Gabon’s forest and agricultural land resources based on the adoption of a new Forestry Code to prevent forest degradation; the creation of 13 new National Parks and other restrictions on land clearance; and the adoption of a National Land Use Plan that allocates land for different uses and explicitly excludes conversion of "intact forests, high conservation value forests and forests which are particularly rich in carbon".

Gabon is the second-most heavily forested country by percent cover, with less than 7% non-forested land (excluding urban and national park areas). Not all of this meets the environmental (precipitation, topography, soil fertility) and economic criteria (accessibility to markets and workforce) for plantation development.

According to the Land Use National Plan (PNAT) under development, some areas of logged-out, degraded or secondary forests with lower than average carbon stocks and where the fauna has been depleted or eliminated by strong hunting pressures, are available for agricultural conversion. The agricultural suitability of these areas needs to be carefully tested and agricultural conversion needs to comply with the Land Use National Plan and the 50% emissions reduction target. Olam contributed to the planning process by sharing information on the agronomic and economic requirements for the development to oil palm and other crops, and by emphasising the environmental and social constraints to be observed in order to comply with international crop sustainability standards.

Olam land leases in Gabon span the full range of habitats from savannah to scrub, wetlands, woody pioneer vegetation, and forests. Some of the first areas proposed did not meet Olam’s Palm Policy criteria, and Olam therefore worked with the Government to pre-select least-risk areas. As no national or international consensus on HCS thresholds existed, Olam only considered operating in secondary and/or logged-over forests where carbon stocks were significantly lower than in mature Central African forests, and only where third party assessment with full public and expert consultation did not reveal the presence of HCVs.

In line with its Palm Policy, Olam then completed a full due diligence and FPIC process for all new palm plantations prior to any development activity. Data collected for the ESIA and HCV assessment included topography and canopy height (provided by wall to wall LIDAR), biodiversity (flora assessment based on forest and savannah plots, mammal fauna assessed

Reference:
6 http://www4.unfccc.int/submissions/INDC/Published%20Documents/Gabon/1/20150331%20INDC%20Gabon.pdf
using transect sign counts followed by camera trapping, and sampling of fish, aquatic invertebrates, and insects), hydrological regime, water quality, soils and soil chemistry, and social data based on socioeconomic surveys and full participatory mapping.

These data were compiled into a regulatory ESIA and Environmental and Social Management Plan for each site, as well as an HCV assessment subject to a broad consultation process (including peer review by the HCV Resource Network for its “Mouila Lot 3” plantation). Olam also shared its HCV and ESIA assessments with NGOs (including national and international critics of the RSPO process), and published its summary findings via its website.

In the final step of the process, Olam completed FPIC negotiations with each affected village and signed a Social Contract with each one specifying the conditions and compensations due for granting Olam access to traditionally managed lands. In the few cases where villages refused to grant access, the community themselves identified the boundaries of their traditional lands and Olam excised them from the plantations.

Figure 2: Location of the three Olam oil palm plantations (Lots 1, 2, and 3) within the Ngounie Province (South Gabon).
Ecological and social context of Olam’s palm plantations in Ngounie Province, South Gabon

Olam has three palm plantations (Lots 1, 2 and 3) in the Ngounie River valley (Figure 2) in a landscape where the savannah component is maintained by recurrent fire.

Most of the forests in Lots 1 and 2 (Figure 3 and 4) are quite young and dominated by the pioneer tree Okoumé Aucoumea klaineana which colonises savannah areas and abandoned farmlands, and does not persist in mature forest. These mixed Okoumé forests have been subject to repeated, patchy logging in the last 60-70 years and are therefore very heterogeneous in quality and composition. Patches of weedy “parasol” trees Musanga cecropioides are also frequently found in former slash and burn agriculture sites.

Older and richer forests with less disturbance, higher biodiversity, more primary forest species and rare or endemic species are found along the Ngounie River floodplain in Lot 1 (Figure 3) and on the plateau in Lot 2 (Figure 4). Lot 3 (Figure 5) consists of 75% savannah, whereas the remaining 25% is degraded, or riparian forest included in protected buffer zones.

The forests within the concessions support a wide range of animal species, albeit at low densities maintained by hunting due to the proximity to villages and roads. Bush meat is traditionally an important part of village diets, and commercial hunting in the past exported large quantities of bush meat to regional markets and the capital, Libreville. The spatial layout of the plantations was designed to conserve the HCV ecosystems and to provide connectivity, allowing animal populations to find refuge in the HCV areas and to move across the landscape within wide forest corridors. Olam has implemented a faunal management plan to halt illegal hunting on its estates.

The different prior conditions in the three lots in terms of the spatial distribution and magnitude of forest above-ground carbon, land-use and planting stage make them ideal to test the carbon estimation and carbon neutral aspects of the HCS+ methodology. While in Lot 1, HCS forests only occur in parts of the concession in patches of various sizes, Lot 2 is characterised by a large proportion of near-continuous HCS forests, whereas Lot 3 had hardly any HCS forest.
Part 3: Gabon Case Study
The HCS+ methodology tested on the ground

Figure 4: Landsat-8 imagery covering Lot 2 prior to development.

Figure 5: Landsat-8 imagery covering Lot 3 prior to development.
Section 4: Landscape Context

Information about the landscape surrounding the concession (such as the continuity of forest cover, location of settlements) provides important context to guide decisions within the concession boundary. HCS+ requires a map that puts the oil palm concession into a landscape context, and includes land cover and land use, hydrological catchments, adjacent conservation areas, agriculture, as well as road and settlement infrastructure. The spatial extent of this map is determined by political, administrative and ecological (e.g. catchment) boundaries. Such a map is most efficiently based on high-resolution satellite imagery (e.g. RapidEye; 5 m spatial resolution) in combination with ancillary GIS data and medium resolution satellite images such as Landsat (30 m spatial resolution) and Sentinel-2 (10 m spatial resolution), because the multispectral bands of Landsat and Sentinel-2 are very useful for the discrimination of different forest types. Stratification using the multispectral datasets must be based on state-of-the-art approaches such as object-based image classification with robust, transferable rule sets.

As the Ngounié province covers most of the relevant landscape outside the three Olam oil palm plantations (Lots 1, 2, and 3), the borders of this administrative unit were chosen as limits for the land cover/use classification. Because of budget and time constraints, land cover/use classification was only based on a single Landsat-8 image from 14/02/2013, which covers the northwestern part of Ngounié province where all three Olam oil palm plantations (Lots 1, 2, and 3) are located (Figure 2).

The location of villages, towns, and bigger cities was retrieved from the Congo Basin Forest Atlas.10

After pre-processing to remove effects of water vapor and aerosols in the atmosphere and seasonal differences in illumination angles, high quality land cover/use maps were generated using an object-based classification approach. Figure 6 illustrates the hierarchical structure of the classification scheme.

In addition, road infrastructure was visually identified and digitised based on Landsat-7 imagery from the year 2003 (05/03/2003) and the Landsat-8 imagery used for the land cover/use classification.

Lacking ground truth data and the limited budget and time to acquire new data in the field prohibited an accuracy assessment of the classification results in this pilot study. When implementing HCS+, however, such accuracy assessment must be performed.

Results

Figure 7 displays the results of this land cover/use classification. The area of the different land cover types is in Table 1.

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10 http://www.wri.org/our-work/project/congo-basin-forests/gabon
Part 3: Gabon Case Study
The HCS+ methodology tested on the ground

Figure 7: Results of this land cover/use classification.

Table 1: Spatial extent of land cover classes in the three lots as of 3 May 2013.

<table>
<thead>
<tr>
<th>Land cover class</th>
<th>Lot 1</th>
<th>Lot 2</th>
<th>Lot 3</th>
<th>Surrounding Landscape</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ha</td>
<td>ha</td>
<td>ha</td>
<td>ha</td>
</tr>
<tr>
<td>Relatively undisturbed or lightly logged forest</td>
<td>21,190</td>
<td>27,234</td>
<td>2,378</td>
<td>1,929,223</td>
</tr>
<tr>
<td>Heavily logged forest</td>
<td>1,438</td>
<td>1,628</td>
<td>1,917</td>
<td>75,427</td>
</tr>
<tr>
<td>Forest after shifting cultivation</td>
<td>109</td>
<td>741</td>
<td>191</td>
<td>65,497</td>
</tr>
<tr>
<td>Savannah</td>
<td>3,232</td>
<td>1,362</td>
<td>18,397</td>
<td>116,510</td>
</tr>
<tr>
<td>Grassland / Shrubland / Cropland</td>
<td>639</td>
<td>375</td>
<td>670</td>
<td>48,339</td>
</tr>
<tr>
<td>Plantation</td>
<td>5,989</td>
<td></td>
<td></td>
<td>6,166</td>
</tr>
<tr>
<td>Wetland</td>
<td>11</td>
<td></td>
<td></td>
<td>7,600</td>
</tr>
<tr>
<td>Bare area</td>
<td>1</td>
<td>10</td>
<td></td>
<td>2,334</td>
</tr>
<tr>
<td>Mining</td>
<td></td>
<td></td>
<td></td>
<td>106</td>
</tr>
<tr>
<td>Settlement</td>
<td></td>
<td></td>
<td></td>
<td>2,831</td>
</tr>
<tr>
<td>Road</td>
<td>76</td>
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<td>39</td>
<td>6,740</td>
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<tr>
<td>Water</td>
<td>197</td>
<td></td>
<td>66</td>
<td>10,339</td>
</tr>
<tr>
<td>No data</td>
<td>1,489</td>
<td>449</td>
<td>52</td>
<td>518,220</td>
</tr>
<tr>
<td>Total</td>
<td>34,371</td>
<td>31,866</td>
<td>23,644</td>
<td>2,789,330</td>
</tr>
</tbody>
</table>
Section 5: Derivation of Spatial Pre-Development Biomass and Soil Maps

The accurate identification of HCS forests requires high-resolution, wall-to-wall (continuous) maps of above-ground carbon at the concession level. One approach to estimating above-ground carbon is based on forest inventories where field measurements (e.g. wood density, trunk diameter and tree height) are converted to above-ground carbon using allometric models. This approach is time consuming and expensive and can only ever sample a very small fraction of the forest area. Above-ground carbon can be also be mapped with airborne LiDAR, which is the only operational tool to generate above-ground carbon estimates at the required level of detail and accuracy. This accuracy results from three facts:

- Higher spatial resolution than any other instrument (sub-metric)
- Higher accuracy with lowest Root Mean Squared Error (RMSE)
- No/next-to-no saturation with respect to AGB

The airborne LiDAR survey for Lot 1 (34,371 ha) and Lot 2 (31,866 ha) was performed in September 2011 using a Leica ALS 60 sensor mounted on a Cessna 402 airplane that flew at an altitude of about 450 m with an average speed of 120 KTAS, which delivered between five and 20 returns per square metre (Burton 2014). LiDAR-derived Digital Terrain Models and Digital Surface Models (spatial resolution of 2 m) were combined to produce a Canopy Height Model (CHM).

Between August and November 2013, the Gabon National Park Agency’s (ANPN) forest monitoring team inventoried 30 one hectare plots within Lot 2. The location of the rectangular plots (40 x 250 m) was determined using a stratified-random sampling design to ensure a wide spatial distribution and an unbiased selection of the plots (Burton 2014). These plots were geo-located using handheld GPSs. Within the plots each individual tree with a diameter-at-breast height (DBH, measured at a height of 1.3 m or above butts) ≥10 cm was measured and where possible identified by species in the field. From those not identifiable in the field, leaves were collected for herbarium identification in Libreville. Tree height was measured using a laser hypsometer, taking heights of 10 randomly selected trees from each of the five DBH subclasses (10-20 cm, 21-30 cm, 31-40 cm, 41-50 cm, and >50 cm).

For each plot regression models were generated to estimate the relationship between tree height and tree diameter (Burton 2014). Published species-specific wood density values were used when available (Burton 2014, Zanne et al. 2009). The AGB values were calculated using the tree height based allometric equation for moist tropical forests (Chave et al. 2014). The above-ground biomass value was calculated for each tree individually, and summed to calculate tonnes of above-ground biomass per hectare.

In order to correlate the AGB field observations with the LiDAR point cloud, two metrics derived from the height histogram were used. The first is based on the Centroid Height (CH) of the histogram, whereas the second one correlates the estimated AGB with the quadratic mean canopy profile height (QMCH) of the histogram (Jubanski et al. 2013, Balhorn et al. 2011, Asner et al. 2010, Lefsky et al. 1999).

One important parameter in LiDAR survey is the point density. The real point density can strongly vary across the surveyed area depending on stripe overlapping, flight velocity, height variation, target reflectance, and return quality degradation by smoke or atmospheric water vapor. In order to account for the variation in point density the point density was used for each plot as a weighting factor in the regression models. As the commonly used power function (Asner et al 2012, Mascaro et al. 2011, Jubanski et al. 2013) can result in an overestimation in the higher AGB range, the AGB regression model proposed by Enghert et al. 2013 was applied which is a combination of a power function (in the lower biomass range up to a certain threshold) and a linear function (in the higher biomass range). For both metrics (CH and QMCH) regression models were derived. The highest correlation was achieved by the QMCH-based regression model with LiDAR point density weighting \( R^2 = 0.80; n = 26, \) excluding four outliers). The resulting AGB maps were derived at 5 m spatial resolution, where each pixel value represents the AGB within a circle of 30 m radius around the center of that pixel (equivalent to approximately 30% of the area of the field plots). This resolution was chosen in order to preserve the maximum spatial detail of the LiDAR data as well as to allow efficient processing of the data. On average, forest in Lot-1 and Lot-2 has an AGB of 280 t/ha and 303 t/ha, respectively. Higher values of up to 900 t/ha occur locally due to the high spatial resolution (25 m\(^2\)) of the LiDAR data set, where a single area element may represent the biomass of a single tree. Above-ground carbon was calculated from the AGB maps by multiplying by a factor of 0.5 (a robust assumption is that biomass has a carbon content of 50%).

As no ground-based calibration data were available for Lot 1, the regression model derived for Lot 2 was also used to produce the above-ground carbon map for Lot 1.

As currently no LiDAR data are available for Lot 3 no correspondent analysis was conducted for this Lot. Instead, the land cover classification presented in Section 4 was calibrated with average above-ground carbon values derived for the land cover types present, and an ‘approximate’ above-ground carbon map was generated based on the “stratify-and-multiply” approach.

11 The correlation between field plot data and LiDAR data only needs to be established once for a given region or range of forest types; a robust regional correlation can then be applied to LiDAR from new forests thus reducing time and cost.
Results

Figure 8 displays the above-ground carbon maps for Lot 1 and Lot 2.

Figure 8: Above-ground carbon maps for Lot 1 (above) and Lot 2 (below). Above-ground carbon derived from LiDAR (prior to any development) and field data (Lot 2 biomass inventory). Spatial resolution 5 m.
Soil maps and soil carbon stocks

With respect to soil carbon it is relevant to achieve two goals:

1. Avoid conversion on High Carbon Stock soils
2. Estimate the total carbon content in High Carbon Stock soils

The application of a soil carbon threshold to limit conversion implies that soils have to be identified where this threshold is surpassed, but not necessarily how far the threshold will be surpassed. When such High Carbon Stock soils are effectively set-aside and protected, their total carbon content is not relevant, because the content will hardly change over time.

In contrast, when peatlands/organic soils are converted to oil palm, the associated drainage will lead to long-term greenhouse gas emissions. How long these emissions will continue, depends on how long the drained situation will persist and how long it takes before the entire peat stock will be depleted.

The soil carbon threshold of 75 tonnes of carbon specified in the HCS+ methodology is already reached with a layer of 15 cm of pure peat. Whilst the carbon density of organic soils with a higher proportion of clastic materials (clay, loam, sand) may be less, it is prudent and conservative to put the threshold for mapping purposes as 15 cm. This means that all lands with an organic layer(s) in the uppermost 30 cm of (cumulatively) 15 cm or more in thickness should be excluded from development.

These lands are on a coarse scale identified by

- The analysis of available geospatial data on peatland, organic soils and useful proxies, field observations, remote sensing data and other available documentation.
- A ‘semi-detailed’ soil survey with one coring per 20 ha, which is standard practice in plantations to assess e.g. soil types for fertility (Barthelmes et al. 2015).

Existing (legacy) soil information for the area has either low resolution or restricted coverage. The 1:2,000,000 ‘Carte pedologique du Gabon’ (Martin 1981) shows for the concessions– in addition to other soil types - also potential High Carbon Stock soil types like gleysols and pseudogley soils with ‘variable, but low accumulation of organic matter’. The 1:200,000 ‘Carte pedologique du Gabon - Fougamou’ (Figure 9) covers Lot 1 and Lot 2 completely and the northern tip of Lot 3 and shows hydromorphic soils, differentiated into peat, ‘medium organic soils’ and mineral soils. The ‘medium organic soils’ include shallow organic soils such as histic gleysols as well as mineral hydromorphic soils (mollic gleysols and umbric gleysols).

Figure 9: Detail of the ‘Carte pédologique de reconnaissance du Gabon - Fougamou (Delhumeau 1974) with the borders of the concessions. Blue colours indicate various (mineral and organic) hydromorphic soils.

The whole of Lots 1 and 3, and approximately 1/3 of Lot 2, are situated in the vast Ngounie river valley depression where wetness maps indicate higher topographic soil wetness and wetland development (Figure 10).

As both the legacy soil maps and modern wetness maps do not sufficiently confirm the presence/absence of High Carbon Stock soils, and drainage and land use may have changed organic soils to mineral soils, the presence of High Carbon Stock soils has to be assessed in the field.

A semi-detailed soil survey (Lot 1) and preliminary soil assessments (Lot 2 and Lot 3) made in the framework of plantation planning (Table 2 based on Param Agricultural Soil Surveys 2014a, b, c) reveal the following picture:

Lot 1 has been surveyed with the highest resolution: for every 20 ha there is one soil observation point; 42 mapping units (different soil types) have been distinguished. Only about a half of Lot 1 has been mapped (Figure 11). The parts where high soil carbon can be expected have largely been excluded from surveying as they were previously identified as HCV areas.
Table 2: Overview of soil survey data for the Olam Mouila concessions (data from Param Agricultural Soil Surveys 2014a, b, c).

<table>
<thead>
<tr>
<th>Lot</th>
<th>Total area (ha)</th>
<th>Surveyed area (ha)</th>
<th>Resolution (ha/coring)</th>
<th>Number of corings (n)</th>
<th>Soil types (n)</th>
<th>Polygons (n)</th>
<th>Pits (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35,354</td>
<td>18,810</td>
<td>20</td>
<td>940</td>
<td>42</td>
<td>185</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>31,811</td>
<td>16,112</td>
<td>50-100</td>
<td>215</td>
<td>9</td>
<td>175</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>23,647</td>
<td>&lt;23,647</td>
<td>50?*</td>
<td>475</td>
<td>10</td>
<td>24</td>
<td>2</td>
</tr>
</tbody>
</table>

Figure 10: Left: Topographic Wetness Index\(^{12}\) of the AFIS database\(^{13}\) for the area. Right: Wetland areas on the wetland map of Karttur.\(^{14}\) Darker blue: Areas with potential high soil wetness or wetland.

Figure 11: Semi-detailed soil map of Mouila Lot 1 (left) and reconnaissance soil map of Lot 2 (right). After Param Agricultural Soil Surveys (2014a, b).
For Lot 2 only one observation per 75 ha is available (probably even less). The number of polygons distinguished is similar to the number of observations made, and the distinguished soil diversity (only 9 units) concentrates in the lowlands. The large hilly part of the lot is mapped as one polygon.

Although the report claims that in Lot 3 the same surveying density has been pursued as in Lot 2, the achieved resolution is not specified. The number of distinguished polygons is comparatively small.

The spatial resolution of the soil surveys in Lots 2 and 3 is below the resolution commonly suggested for plantation planning in Southeast Asia (Paramananthan, 2011) and similarly below the basic resolution advised in the HCS+ methodology for the detection of high carbon soils. We have, however, the impression that through the prudent lay-out of HCV areas, High Carbon Stock soils have been effectively excluded from the planted area and - within the concession boundaries - are only found in the set-aside areas. This impression was supported by observations and incidental coring during a field visit.

Furthermore, there is yet no indication that High Carbon Stock soils within the set-aside areas will be hydrologically affected by development outside the set-aside areas (especially through drainage), so that they would have to be mapped in detail to determine their organic layer depth and carbon content. The rather narrow buffer zones along minor streams and rivers may, however, not be sufficiently wide to protect against eutrophication from fertiliser nutrients applied to the plantation, especially on steeper slopes. This aspect requires monitoring and, if required, adaptive management.
Section 6: Evaluation of Approaches to Carbon Neutral Development

The workflow describing the HCS+ methodology for planning for carbon neutral development is shown in Figure 12.

Water bodies, sacred places and village plantations were excluded from the concession areas. Subsequently identified HCV areas were set aside leading to a differentiation into HCV set asides and potentially plantable areas. Based on the land cover classification (see Section 4) the HCV set asides were split into savannah and forest.

Within the HCV set aside savannahs no carbon accumulation was assumed. Based on the LiDAR above-ground carbon map (see Section 5) and patch size analysis, HCS forest areas were identified. Above-ground carbon values were assigned to each pixel (5 x 5 m²) with an above-ground carbon threshold of more than 75 tonnes of carbon per hectare or a soil carbon content of higher than 75 tonnes of carbon per hectare which is equal to an organic layer of more than 15 cm depth. As none of the three Lots contained High Carbon Stock soils outside the HCV areas (see Section 5), the effects of conversion on soil carbon could be neglected (see also Part 2 of this report).

Within the requirement of carbon neutrality, the HCS+ methodology allows conversion of HCS forest patches (outside HCV and FPIC areas) if they do not exceed 10 ha in area, so as to reduce fragmentation and facilitate the practicalities of laying out new plantations. Within the HCV and HCS set-aside forests (dark green and white in Figure 12), a carbon accumulation of 2.5 tonnes of carbon per hectare per year was used for illustrative purposes. This is equivalent to the average rate for regenerating secondary forests (Box 1) and similar to the rate of 2.4 tonnes of carbon per hectare per year reported during recovery of forests after logging in the Central African Republic (Gourlet-Fleury et al. 2013). This rate is higher than the ‘conservative’ rate recommended as a global default based on many studies (Box 1).
Part 3: Gabon Case Study

The HCS+ methodology tested on the ground thus modelled development scenarios, not those actually implemented on the ground. The spatial results for Lot 1 are presented in Figure 13 as an example of the results of the HCS+ method in a representative concession containing significant proportions of each of the land cover classes present in the landscape.

In Lot 1, the plantable area is 7,853 ha or 21% of the concession area. The planting of these 7,853 ha would generate a net carbon gain of 7,141 tonnes of carbon (tC) over the whole rotation period, resulting from balancing the carbon losses resulting from conversion of forest with higher above-ground carbon (amber areas) against the carbon gains resulting from planting on land with low above-ground carbon (green areas). Plantation infrastructure (roads etc.) causes further carbon losses of 6,832 tC. Overall, the planted area has a slightly positive carbon balance of 309 tC. Assuming average carbon accumulation rates of 2.5 tC/ha/yr, the set-aside of 9,322 ha of HCS forest (not including HCV) in Lot 1 leads to carbon gains of 582,625 tC and the set-aside of 17,312 ha of HCV forest adds another 1,081,991 tC of carbon gains over the rotation period of this concession (Table 3). Therefore, overall Lot 1 would be about 1.6 million tC positive. Figure 13 shows the corresponding map of what HCS+ development would look like in Lot 1.

**Box 1: Accumulation of carbon is set-aside forests**

The carbon neutral procedure of the HCS Science Study assumes that all forests set-aside during the concession planning contribute positively to the carbon balance of the entire concession. These forests may be set aside because they are above the HCS threshold, because they are HCV forests, or because they were excluded following the FPIC procedure. Carbon accumulation in forests has been studied in forests, spanning a wide range of disturbance intensities. There is a wide variation in the carbon accumulation potential of different forest types.

Secondary forests re-growing after clearing accumulate on average 2.5 tonnes of carbon per hectare per year over a 25-year period (the typical rotation cycle of an oil palm plantation; Consulting Study 4). This means that such land set aside for protection would accumulate on average 62.5 tonnes of carbon per hectare after 25 years. The typical error on this value is estimated at 17 tonnes of carbon per hectare (Chave 2015), so the effective range of values is 45-80 tonnes of carbon per hectare.

Partially-logged forests regenerate differently than secondary forests. Estimates based on a limited number of long-term managed forest experiments suggest that the carbon accumulation rate is closer to 1.5-2 tonnes of carbon per hectare per year (Rutishauser et al. 2015; Chave 2015). This suggests that the 25-year carbon accumulation potential is 37-50 tonnes of carbon per hectare in forests regenerating after partial logging.

Finally, mature tropical forests are also predicted to accumulate carbon as a result of the so-called carbon dioxide fertilisation effect by a magnitude of 0.5-0.9 tonnes of carbon per hectare per year (Pan et al. 2011). This would represent a baseline accumulation of worldwide forests of 12-22 tonnes of carbon per hectare over 25 years. However, this effect tends to saturate over time (Brienen et al. 2015) and it is also unclear to what extent secondary and managed forests are sensitive to this fertilisation effect to the same extent as mature forests.

In the HCS Science Study, we assume that most forests set aside have been exposed to prior logging at various intensities and are therefore accumulating carbon. The actual carbon accumulation by these set asides must be estimated by conducting further LiDAR surveys during the rotation after the baseline survey. Repeated LiDAR surveys hold a great potential for estimating the carbon accumulation at high spatial resolution (Réjou-Méchain et al. 2015).

For initial planning for carbon neutral development we propose to use a conservative estimate of the carbon accumulation rate, in the absence of robust regional estimates supported by peer-reviewed science. Given the values reported above, we propose that this should be 1.5 tonnes of carbon per hectare per year for typical HCS and HCV forest landscapes in areas exposed to oil palm plantation development. Use of less-conservative values that have not been locally verified, may expose the developer to high risk. Subsequent monitoring will determine whether requirements to achieve carbon neutrality are on track.

For each pixel of the above-ground carbon (AGC) map within the plantable area, the net carbon balance was calculated as $C_{\text{net}} = C_{\text{AGC}} - 30 \, \text{tC/ha}$ above-ground carbon (i.e., the time-averaged carbon stock of a typical palm oil plantation minus above-ground carbon present prior to conversion). The plantable areas were thus separated into areas providing net carbon gains (where 30 - AGC was >0; green in Figure 12) and areas where there was carbon loss (30 - AGC <0; amber in Figure 12). To account for the loss of carbon due to plantation infrastructure construction, a default area value of 2.9% was used (Goh 2015, pers. comm.), which were assumed to lose all carbon, without regaining any carbon. Finally, the carbon balance was calculated by summing up all the following (+ and -) components (see Figure 12): carbon gain (green) and carbon loss (amber) in the plantable area, carbon accumulation within HCS forest set aside and HVC set aside (forest), and full carbon losses with no carbon gain in infrastructure areas.

**Results**

Table 3 and Figure 13 summarise the results of the carbon balance calculations after applying the HCS+ methodology, based on an above-ground carbon threshold of 75 tC/ha and a minimum HCS patch size of 10 ha. These results are thus modelled development scenarios, not those actually implemented on the ground. The spatial results for Lot 1 are presented in Figure 13 as an example of the results of the HCS+ method in a representative concession containing significant proportions of each of the land cover classes present in the landscape.
In Lot 2, the plantable area under HCS+ would only be 3,817 ha or 12% of the concession area. The planting of these 3,817 ha would generate a net carbon loss of 36,294 tC over the whole rotation period, resulting from balancing carbon losses from conversion of forest with higher above-ground carbon (amber) and carbon gains resulting from planting on land with low above-ground carbon (green). Plantation infrastructure causes further carbon losses of 3,321 tC. Overall, the planted area would have a negative carbon balance of 39,615 tC. These emissions are balanced by the set-aside of 6,934 ha of HCS forest (not including HCV), which leads to carbon gains of 433,390 tC, and the set-aside of 18,010 ha of HCV forest which adds another 1,125,621 tC over the rotation period. The overall carbon balance in Lot 2 is thus nearly 1.5 million tC positive (Table 3).

Similar analyses are presented for Lot 3, even though a LiDAR-based above-ground carbon assessment is lacking for this area. Due to the dominance of low above-ground carbon cover types, 21,257 ha or 90% of the concession would be plantable, which provides carbon gains of 366,330 tC over the rotation period, resulting from carbon gains from the plantings (455,472 tC) in areas with lower above-ground carbon (green) and carbon losses of 89,142 tC in areas with higher above-ground carbon (amber). Infrastructure accounts for carbon losses of 18,494 tC, which is highest among all Lots, due to the larger plantable area. The overall carbon balance of the planted area in Lot 3 remains positive at 347,836 tC. Adding to this positive balance is the set-aside of 2,388 ha of HCS forest, which sequesters another 149,248 tC over the rotation period of the concession. The overall carbon balance in Lot 2 is thus equal to nearly 0.5 million tC (Table 3).

The results for applying a more conservative carbon accumulation rate of 1.5 tC/ha/yr in the set-asides are shown in Table 4. All Lots are still highly carbon positive.

In all three lots the carbon balance is highly positive mainly due to the large areas of set-aside forests, and would thus make a significant contribution to climate change mitigation.

Importantly, all these calculations assume that the set-aside forests will accumulate carbon over the 25-year plantation cycle, which is only realistic if the forests have undergone logging or other disturbance prior to the concession establishment (a condition that is verified in Lots 1, 2 and 3), and that such carbon accumulation would not have occurred without protection because of encroachment (i.e. the carbon accumulation is additional to that which would have otherwise occurred). In the study area, the baseline scenario without Olam would be that there is a fluctuating state of the forest at somewhat less than mature biomass. This is currently the case due to earlier logging, and it is reasonable to assume that current practice of anarchic logging would continue when enough saleable timber has built up. Olam have stopped the incursion of illegal logging in their set-asides.

Table 3: Different components of the carbon balance calculations for the three Lots, assuming carbon accumulation rates of 2.5 tC/ha.

<table>
<thead>
<tr>
<th></th>
<th>LOT 1</th>
<th>LOT 2</th>
<th>LOT 3***</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Above-ground carbon threshold</strong></td>
<td>75 t C ha⁻¹</td>
<td>75 t C ha⁻¹</td>
<td>75 t C ha⁻¹</td>
</tr>
<tr>
<td><strong>Patch size</strong></td>
<td>10 ha</td>
<td>10 ha</td>
<td>10 ha</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>[ha]</td>
<td>[ha]</td>
<td>[ha]</td>
</tr>
<tr>
<td><strong>Carbon gains (+) and losses (-)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[t C]</td>
<td>[t C]</td>
<td>[t C]</td>
<td>[t C]</td>
</tr>
<tr>
<td>Plantable*</td>
<td>7,853 ([21%]</td>
<td>3,817 ([12%])</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
<td>21,257 ([90%])</td>
</tr>
<tr>
<td>Carbon loss</td>
<td>3,214</td>
<td>2,198</td>
<td>-72,235</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,202</td>
<td>18,471</td>
</tr>
<tr>
<td>Carbon gain</td>
<td>4,639</td>
<td>116,472</td>
<td>1,620</td>
</tr>
<tr>
<td></td>
<td>-109,331</td>
<td>35,942</td>
<td>18,367</td>
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<tr>
<td></td>
<td>+7,141</td>
<td>-36,294</td>
<td>+366,330</td>
</tr>
<tr>
<td>Infrastructure**</td>
<td>228</td>
<td>-6,832</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-3,321</td>
<td>616</td>
</tr>
<tr>
<td>Carbon balance from planting</td>
<td>+309</td>
<td>-39,615</td>
<td>-18,494</td>
</tr>
<tr>
<td>HCS forest</td>
<td>9,322</td>
<td>+582,625</td>
<td>6,934</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+433,390</td>
<td>2,388</td>
</tr>
<tr>
<td>HCV forest</td>
<td>17,312</td>
<td>+1,081,991</td>
<td>18,010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+1,125,621</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>2,096</td>
<td>-</td>
<td>2,844</td>
</tr>
<tr>
<td>Total carbon balance</td>
<td>36,583</td>
<td>+1,664,925</td>
<td>31,606</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+1,519,397</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>23,645</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+497,084</td>
</tr>
</tbody>
</table>

* in [ ] the per centage plantable of the whole lot area after the HCS assessment is given.
** no carbon gains from oil palm plantation, due to infrastructure.
*** Note that the analysis presented for Lot 3 is based on a different approach.
Table 4: Different components of the carbon balance calculations assuming a ‘conservative’ carbon accumulation rate of 1.5 tC/ha/yr in set-aside forests for the three Lots.

<table>
<thead>
<tr>
<th></th>
<th>LOT 1</th>
<th>LOT 2</th>
<th>LOT 3***</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Above-ground carbon threshold</strong></td>
<td>75 t C ha⁻¹</td>
<td>75 t C ha⁻¹</td>
<td>75 t C ha⁻¹</td>
</tr>
<tr>
<td><strong>Patch size</strong></td>
<td>10 ha</td>
<td>10 ha</td>
<td>10 ha</td>
</tr>
<tr>
<td><strong>Area [ha]</strong></td>
<td>Carbon gains (+) and losses (-) [t C]</td>
<td>Carbon gains (+) and losses (-) [t C]</td>
<td>Carbon gains (+) and losses (-) [t C]</td>
</tr>
<tr>
<td>Plantable*</td>
<td>7,853 [21%]</td>
<td>-</td>
<td>3,817 [12%]</td>
</tr>
<tr>
<td>Carbon losses</td>
<td>3,214</td>
<td>-109,331</td>
<td>2,198</td>
</tr>
<tr>
<td>Carbon gains</td>
<td>4,639</td>
<td>116,472</td>
<td>1,620</td>
</tr>
<tr>
<td>Infrastructure**</td>
<td>228</td>
<td>-6,832</td>
<td>111</td>
</tr>
<tr>
<td>Carbon balance from planting</td>
<td>+7,141</td>
<td>-36,294</td>
<td>+7,141</td>
</tr>
<tr>
<td>HCS forest</td>
<td>9,322</td>
<td>+349,575</td>
<td>6,934</td>
</tr>
<tr>
<td>HCV forest</td>
<td>17,312</td>
<td>+649,200</td>
<td>18,010</td>
</tr>
<tr>
<td>Other</td>
<td>2,096</td>
<td>-</td>
<td>2,844</td>
</tr>
<tr>
<td>Total carbon balance</td>
<td>36,583</td>
<td>+999,084</td>
<td>31,606</td>
</tr>
</tbody>
</table>

* in [ ] the percentage plantable of the whole lot area after the HCS assessment is given.
** no carbon gains from oil palm plantation, due to infrastructure.
*** Note that the analysis presented for Lot 3 is based on a different approach.

Figure 13: HCS+ assessment Lot 1. Spatial results of the carbon balance calculations based on an above-ground carbon threshold of 75 tonnes of carbon per hectare and a minimum HCS patch size of 10 ha.
Part 3: Gabon Case Study
The HCS+ methodology tested on the ground

Comparison between HCS+ Methodology and Olam Land Use Plan

Table 5: Area planted, area of HCV forest and net carbon balance of Lots 1, 2 and 3.

<table>
<thead>
<tr>
<th>Concession</th>
<th>Area planted</th>
<th>HCV forest/buffer zones</th>
<th>Carbon balance (tC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lot 1</td>
<td>17,175</td>
<td>17,312</td>
<td>+47,357</td>
</tr>
<tr>
<td>Lot 2</td>
<td>10,752</td>
<td>18,010</td>
<td>+424,209</td>
</tr>
<tr>
<td>Lot 3</td>
<td>17,000</td>
<td>6,680</td>
<td>+845,230</td>
</tr>
<tr>
<td>Total Net carbon balance</td>
<td></td>
<td></td>
<td>1,316,796</td>
</tr>
</tbody>
</table>

Carbon balances for the Olam land use plan are based on the actual areas planned to be converted and the corresponding above-ground carbon on those areas, carbon sequestered by oil palms, and carbon sequestration by HCV set-asides.

Figure 14 displays the Olam land use plan for Lots 1 and 2. The net carbon balance of those plantings is summarised in Table 5. The calculation for Lot 3 comes with the caveat that we did not have LiDAR estimates of carbon, and the Olam land use plan is still subject to some final adjustments. We have used approximate Figures provided by Olam (planted area of 17,000 ha including 16,500 ha savannah and 500 ha low-carbon forest, for which we assumed a carbon value equivalent to amber areas of Lot 1). The carbon balance based on Olam’s actual land use plans is slightly positive in Lot 1 and highly positive in Lots 2 and 3. Actual accumulation in Lot 1 was +47,357 tonnes of carbon (tC) (compared to +1,664,925 tC under the HCS+ model) based on -1,034,634 tC net carbon losses from the conversion of land to plantations and infrastructure, and +1,081,991 tC net gains from the conservation of HCV forest. Total gains in Lot 2 were +424,209 tC (compared to +1,519,397 tC under the HCS+ model) based on -701,412 tC net carbon losses from the conversion of land to plantations and infrastructure, and 1,125,621 tC carbon net gains from the conservation of HCV forest.

The carbon balance for Lot 3 is estimated to be net positive +845,230 tC based on gains of 427,730 in planted areas, and gains of 417,500 tC in the HCV/buffer zone forests. The carbon balance under HCS+ would be positive by 497,084 tC. The greater carbon balance relative to the HCS+ model is due to the fact that virtually all the planting is in savannah, and most of the non-HCS (amber) forest in Lot 3 is in practice included in buffer zones and/or HCV areas.

Due to the large extent of HCV forest in the Mouila palm plantations, the net carbon balance of the three lots is sensitive to the selection of a default carbon accumulation rate in HCV set asides. Using the more conservative value of 1.5 tC/ha/yr, the overall carbon balance across the three Lots is net positive 192,117 tC over the plantation cycle. Therefore, the implemented Olam land use plan should yield a climate benefit, contingent on the effective protection of HCV areas from further encroachment.
Figure 14: Land Use plan of Olam for Lot 1 and Lot 2.
For both Lots 1 and 2 the HCS+ methodology is much more restrictive than the land use plan of Olam, because a major part of the plantable area in the actual land use plan (areas identified as non-HCV forest) is categorised as HCS forest under the HCS+ threshold of 75 tonnes of carbon per hectare. On the other hand, Olam’s land use plan for Lot 3 is more restrictive than the HCS+ method, because most of the non-HCS forests are in practice conserved as riparian protection zones.

Effect of varying patch size and thresholds

We also modelled the effects of varying patch sizes and different carbon thresholds on the areas of land that could be developed, and the corresponding carbon balances for Lots 1 and 2. As an example the results for Lot 1 are summarised in Figure 15 and 16.

Three main conclusions emerge:

- When applying the HCS+ above-ground carbon threshold of 75 tC/ha, a relatively small proportion of Lots 1 and Lot 2 could be planted - 21% for Lot 1 and for Lot 2 only about 14%. Applying an AGC threshold of 35 tC/ha, which approximates that used in the HCS Approach, significantly reduces the plantable area to only 14% in Lot 1, and in Lot 2 very little forest could be converted.

- If the above-ground carbon threshold for HCS forest is increased considerably, in the specific case of Olam’s plantations, the overall carbon balance remains positive because of the significant areas of HCV set-asides. Even applying no threshold (everything plantable except HCV areas) would not lead to a negative carbon balance.

- Varying minimum HCS patch sizes (size of fragments) between 10 and 200 ha did not result in a much change in the percentage of plantable area. For example in Lot 1 the percentage of plantable area increased from 21% (10 ha patch size) to 23% (200 ha patch size). For Lot 2 it decreased slightly with increasing patch size. However use of a patch size of 10 ha is considered precautionary for protection of HCS forest. However, as discussed in Part 2 of the main Report, much larger patch sizes may be required for the long-term viability of tropical forests. It has to be noted that the patch analysis used here is only based on patch size and does not consider patch connectivity or the discrimination of core and edge forest or any other elements of fragmentation analysis.

Figure 15: Lot 1 - Effect of varying patch size for an above-ground carbon threshold of 75 tonnes of carbon per hectare. The upper diagram displays the area and the lower diagram the corresponding components of the carbon balance. The bold numbers in the lower diagram are the overall carbon balance in Mt.

Figure 16: Lot 1 - Effect of varying the above-ground carbon threshold (N/A means no threshold was applied) when using a HCS patch size of 10 ha. The upper diagram displays the area and the lower diagram the corresponding components of the carbon balance. The bold numbers in the lower diagram are the overall carbon balance in Mt.
Section 7: Socio-Economic Context and Impacts

The overriding objective of Olam’s joint venture partner, the Government of Gabon, in promoting the development of oil palm, is to boost the socio-economic well-being of its population. As mentioned above, the context includes the country’s over-reliance on income from oil extraction, its relatively high unemployment rate of 26% and high level of food importation of 60%. There are also relatively high levels of urbanisation and inequality. Development is concentrated in the capital Libreville, where over half of the population live, with the rural population generally experiencing lower incomes and poorer access to infrastructure.

Olam is also strongly committed to achieving RSPO certification, and as discussed above, has aimed to implement all the steps necessary to ensure full compliance. This has included undertaking HCV assessments and Environmental and Social Impact Assessments (ESIAs) including participatory mapping, and developing detailed Environmental and Social Management Plans (ESMP) based on the findings of these assessments. Olam has also followed Free, Prior and Informed Consent (FPIC) processes to obtain the consent of communities affected by the concession.

The socio-economic element of this case study has not attempted to assess the nature of Olam’s compliance with RSPO requirements or to evaluate the socio-economic impacts of its operations in relation to the developmental goals of the Gabonese government. Instead it examines the company’s approach in relation to the practices and processes advocated by the HCS+ socio-economic methodology and the issues raised by the HCS socio-economic case studies. This exercise has been carried out to the extent possible given the considerable time and data constraints, and is based mainly on assessment reports provided by Olam as well as a brief period of fieldwork. The socio-economic element of the fieldwork included discussions with Olam staff, a visit to a village benefiting from an income generation project supported by Olam, and a meeting with some of the relevant NGOs in Libreville. Additional information as recommended by the HCS+ methodology and set out in Part 2 of the larger report, such as an independent audit of FPIC prior to land conversion and the collection of data on impacts for the Palm Oil Welfare Index (POWI), is not a requirement of the RSPO and thus was not carried out by Olam. Such data would have been a useful input into this kind of evaluation exercise however.

A key finding of some of the socio-economic case studies commissioned by the HCS Science Study has been the variable adherence historically by companies to RSPO standards and guidelines, particularly in relation to obtaining the FPIC of affected communities and ensuring that their livelihoods are protected (Atkinson 2015, Colchester et al. 2015, Zen et al. 2015). This has led in some cases to increased food insecurity and to conflicts between communities and companies. Olam in contrast appears to have made significant efforts to meet the RSPO requirements fully. Key elements of their approach include the timely inclusion of socio-economic considerations, which were integrated into the planning of the operation from the start, the thoroughness with which the findings from the assessment phase have been reflected in management planning, and the attention to detail at all stages. Management plans highlight the various steps that are being taken in response to each area of concern identified in the assessment phase, and set out action plans with multiple indicators to assess adherence including timing and personnel responsible. Again though, it has not been possible to verify the extent to which all elements of the management plans have been applied in practice.

During the preparatory phase, the company held consultations with all affected villages in the concession area that consented to participate, in order to inform them of their plans and to allow them to express their concerns about the development. Participatory mapping was also conducted. These information-sharing and communication exercises then formed the basis for the development of social contracts between the company and the various communities, as well as for their formal consent to the project. Two villages in Mouila Lot 2 refused to participate even in the consultative and mapping phase, consenting only to map the limits of their traditional lands. Sizeable areas of land around their villages were excised from the concession as a result. Key issues raised by communities during this consultative phase included the loss of access to forest land for farming, hunting and gathering, and concerns over the potentially negative impacts of an influx of workers from outside the area.

In response to the first issue, Olam has committed to establishing a programme in conjunction with local development agencies to boost food security. According to the management plan, implementation is to be demonstrated by evidence of plot mapping and the provision of seedlings to interested farmers, as well as records of revenues from the sale of produce. These should be produced within the first year of operation. A field visit to a 15 hectare manioc farm showed that one large project has been established, with assistance for clearing, materials and training having been provided by a local development NGO. Those involved were looking forward to reasonable returns from their labour inputs. Buffers of several kilometres around each village have also been established as requested by communities, in order to ensure sufficient land availability for their other activities, with generous overall set-asides for livelihood purposes. The plantation site allocation was also partly guided by a desire not to surround villages on both sides in response to a concern raised by many communities.

15 For example, Mouia 2 Summary Report of Planning and Management
16 Ibid., p. 10
17 Field visit to Rembu village, 30 July 15
18 EIA Mouila lot 1, p.148
Food security will also be supported via company commitments to favour locals for employment and to restrict access to environmental set-asides for hunting and other activities to locals only. This element forms part of broader faunal management plans which are being implemented in partnership with the Ministry of Forestry, a neighboring Forest Stewardship Certification (FSC) concession (in the case of Lot 2) and a national NGO partner. These efforts are also likely to help address concerns about the impacts of an influx of workers from outside the area (although 98% of workers are Gabonese), and are being implemented through education of both locals and outsiders. Indicators to measure these processes include attendance records of awareness raising meetings and interviews to check workers’ understanding of the hunting restrictions.19 These measures together should help to protect the set-asides from encroachment, which is generally related to insufficient alternative livelihood provision. Although it is too early to assess their effectiveness, there are no major reported issues so far.20

The company’s next phase of development involves assisting smallholder food and cash-crop production, mainly oil palm. Although this is located in a different area from the main oil palm concession, this should also contribute to food security by boosting local production of staple foods including manioc and maize, thereby helping to keep prices stable.

Local monitoring committees have been established in communities to ensure their concerns are addressed and any grievances aired.21 Minutes of committee meetings provide evidence that these have been established, which should happen prior to land clearing, while ongoing reports should show progress in relation to social commitments. The company’s social manager is responsible for this monitoring and for the food security elements.22

The social team also monitors progress in relation to social infrastructure provision, a key aspect of the company’s social contracts with communities. Provision varies according to the requests of different villages, but generally includes electrification through solar street lights, provision of water pumps and improvements to the generally inadequate health and education services provided by the government. While needs and priorities of communities do vary, the different provision may also reflect their varying abilities to negotiate effectively, and greater standardisation may be preferable to ensure equity between villages, as recommended by the HCS+ methodology. The NGO community in Gabon appears to be broadly supportive of Olam’s operations, based on discussions in a meeting organised by the company. Participants emphasised the marked contrast with past experiences with oil palm development in the country, in which FPIC was not followed and community concerns were relegated.23 Olam’s efforts to secure FPIC and its respect for community rights have thus been highly welcome, with the right of communities to refuse development despite the prior allocation of the land they occupy to the concession is particularly remarkable in a country used to strong central control.24 Another positive aspect has been the innovative 360 degree participatory mapping that the company has developed in conjunction with the Institute of Tropical Ecological Research (IRET). This has enabled the broader context and expected impacts of the company’s operations to be taken more fully into account.25 It is difficult to assess the actual impacts of Olam’s operations so far without much more detailed data collection. The application of the Palm Oil Welfare Index (POWI) or a similar impact measurement tool would be very useful in order to ascertain more precisely the effects of Olam’s operations on community income, food security and access to social infrastructure. Relevant data from existing Olam ESIs could provide a useful baseline for this process and the company is committed to ongoing data collection, although not necessarily as systematically as would be required for the POWI. The longer term impacts of the company’s operations also have yet to be felt fully given their very recent establishment, although some improvements in poverty and unemployment indicators have already been observed.26 In addition as discussed in Section 4, in lands surrounding the concession high resolution remote sensing (RapidEye) could be used to help delineate set aside lands used by local communities and to monitor their condition.

The company currently employs about 4,400 people in its 3 sites in the Mouila area, making it by far the largest formal sector employer in the area. This is expected to increase as production comes on-stream and harvesters and mill workers are required. The basic wage of approximately US$300 (the national minimum wage for unskilled workers) appears respectable compared to regional and international standards,27 although is lower than what can be made locally by skilled workers in the timber sector.28 A key concern in relation to labour arises from the country’s low population and its concentration in the capital city, although there is some evidence already of a return of unemployed youth to rural areas to take up newly created jobs.29 Labour availability is not yet a constraint, as outsiders from different parts of the}

19 Mouila 2 summary report of Planning and Management, p.10.
20 Olam management during field visit 30 July 15.
21 EIA Mouila lot 1, p.213.
22 Moula 2 summary report of Planning and Management, p.9.
23 NGO meeting in Libreville on 1 August 2015, Gabon (World Wildlife Fund, BrainForest, ONG Croissance Environnement, Initiative Développement Recherches Conseils [IDRC], Conférence des Forêts Denses et Humides d’Afrique Centrale [CEFDHAC]).
24 Ibid.
25 Ibid., Conférence des Forêts Denses et Humides d’Afrique Centrale (CEFDHAC).
26 Ibid., WWF.
27 Comparable to Malaysia and Indonesia, and double the standard wage in Liberia which equates to around US$150/month.
28 EIA Mouila Lot 1, p.141.
29 Social manager, held visit on 30 July 2015.
country have filled any jobs not taken by locals. Turnover and absenteeism are both high however, reflecting the relative newness of fulltime workforce participation.30 The social impacts of the in-migration that will be necessary to fulfill labour requirements are unclear at this stage but are likely to remain a key concern for locals.

The extent to which the company is adhering to regulations on labour conditions, land rights, livelihoods and cultural assets is difficult to ascertain without a full investigation. Independent verification at various stages before the first RSPO certification audit, which is only undertaken when oil production commences, as suggested by the HCS+ methodology, would help considerably in this regard. It is clear however that Olam has adopted a highly responsible approach to the socio-economic aspects of its operations. From what can be observed from the process so far, the key elements of consent, careful policy-making based on detailed assessments, transparency and sufficient communication with communities, are all in place.

The company has benefited from various factors specific to the situation in Gabon. The partnership with the Gabonese government has contributed to the developmental focus of the operation and to its comprehensive, holistic and long-term perspective. This can be seen in the thoroughness of the pre-planning phase and the integrated nature of the company’s activities in the country which include large-scale plantations, industrial production of inputs and the proposed smallholder scheme. The relatively strong capacity of the government has also contributed to the creation of a conducive context for the company’s operations, including in relation to the broader land-use planning issues that are particularly challenging in a highly forested environment.

The country’s low population density has been a further key factor that has greatly facilitated the ability of the company to identify and clear sufficient land for its plantations, while still allocating large environmental and livelihood set-asides. In Mouila Lot 2 for example, only 13 villages were affected, 5 only marginally, and only 2 strongly.31 This has also presumably helped reduce the cost of the social assessments and policy responses. The company’s investment in and commitment to these aspects has however certainly contributed to the relative success of its operations so far and demonstrates clearly the value of investing in this area.

30 Comments from local managers at plantation sites on 30 - 31 July 2015
31 HCV Assessment, Mouila Lot 2
Section 8: Conclusions

The case study of Olam’s oil palm development in Gabon provided the opportunity to assess some aspects of the feasibility of the HCS+ methodology. We conclude that the HCS+ method to map biomass based on LiDAR data is practical and effective. The LiDAR analyses applied to two concessions provide the information base to plan concessions that are carbon neutral or carbon positive. The case study highlights the challenges of applying the HCS+ thresholds in highly forested landscapes. In such situations, limited areas are available for development, and where protected set-asides of either HCV or HCS forests are large, the overall development will be highly carbon positive. In savannah landscapes, most of the area can be developed and carbon neutrality easily achieved.

The case study also indicates that Olam has taken considerable care to provide benefits to local communities in line with HCS+ recommendations.

Further application of the HCS+ method to this case study would involve repeated monitoring of carbon sequestration in set asides to confirm that anticipated rates of carbon sequestration. For the HCS+ socio-economic methodology, monitoring local communities for food security and other welfare attributes would provide the information needed for effective management that achieves positive socio-economic outcomes.

The case study is representative of oil palm development in highly-forested landscapes with low human population densities. This situation is similar to other places in Central and West Africa but less similar to Southeast Asia. Further case studies are required to assess the feasibility and to refine the HCS+ method for a range of situations, with attention to cost-effectiveness of implementing the method.
Section 9: References


Part 3: Gabon Case Study
The HCS+ methodology tested on the ground


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