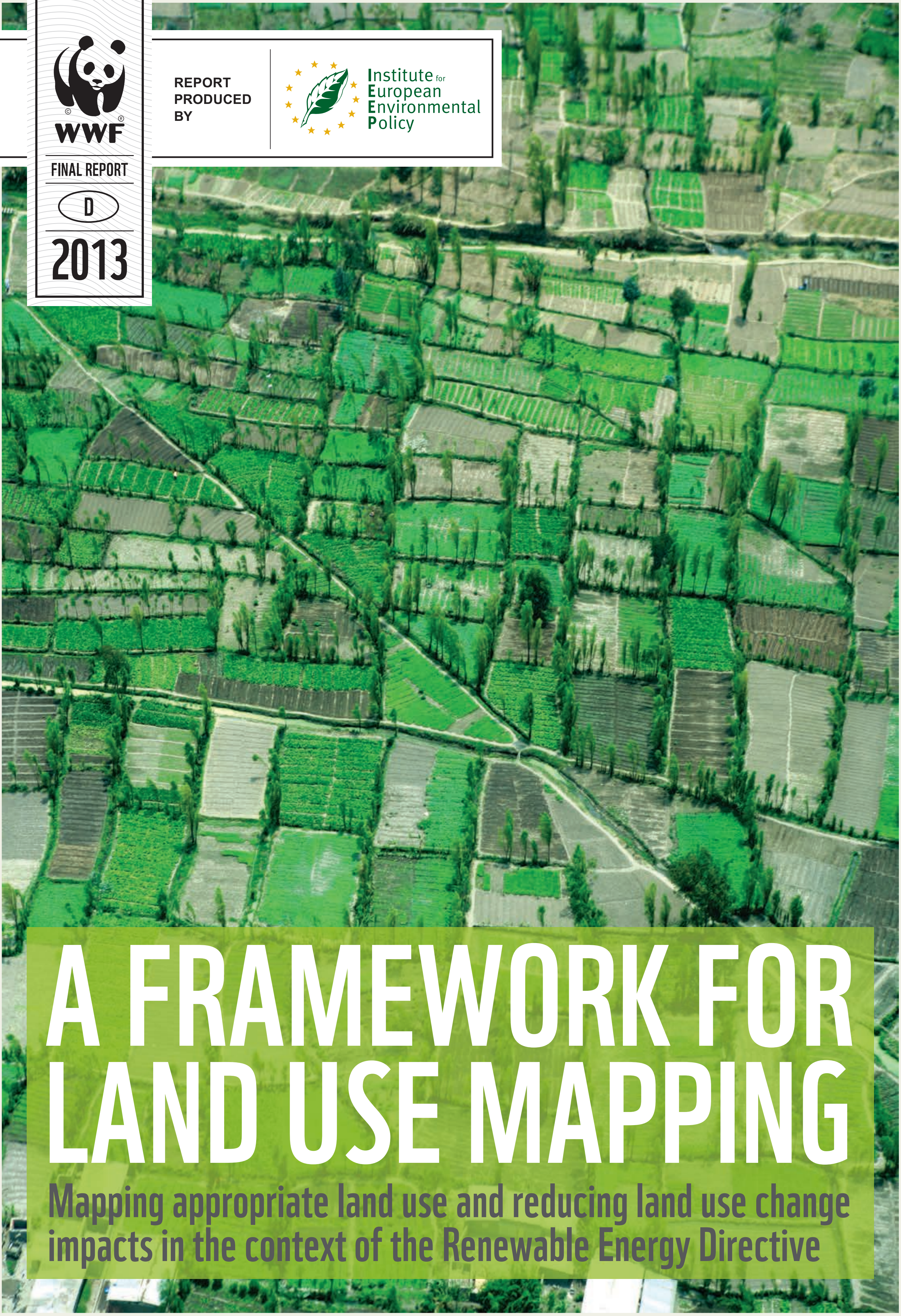

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A FRAMEWORK FOR LAND USE MAPPING

Mapping appropriate land use and reducing land use change impacts in the context of the Renewable Energy Directive

Disclaimer: The arguments expressed in this report are solely those of the authors, and do not reflect the opinion of any other party. Any errors that remain in the report are the responsibility of the authors.

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EXECUTIVE SUMMARY

This report contributes to the WWF Sustainable Land Use (SuLu) Project, by providing policy and methodological guidance for the mapping of appropriate land use that aims to ensure the production of sustainable biofuel feedstocks with minimal environmental impacts. This is to support a broad range of ongoing and future biofuel related land use mapping initiatives. It also makes specific recommendations to the European Commission on how to assess land use planning maps, were these are submitted by certification schemes as evidence of compliance with sustainability criteria contained within the EU's Renewable Energy Directive (RED). In addition the report addresses the suitability of land use planning as a tool to mitigate indirect land use change (ILUC).

There are a number of ways in which land use maps and surveys can be used to help reduce environmental impacts of biofuels (and potentially other commodities) by ensuring compliance with sustainability criteria, for example those in the RED. A range of overlapping and interacting approaches could be envisaged which are grouped into **three broad categories of approaches**:

- Indicative guidance maps provide information on environmental status and values (eg protected areas, biodiversity values), without making explicit judgements on the whether biofuels should be produced in a specific location.
- Definitive compliance maps (potentially including areas of uncertain status or specified risk status) aim to ensure compliance with defined sustainability standards such as those of the RED or other voluntary criteria.
- On-site assessments, eg as the basis for a comprehensive simple project-level approach to the accreditation of biofuel production.

Considering the relative advantages and disadvantages of the different approaches (Section 4.2), it is clear that they are likely to form part of a process that evolves from coarse indicative mapping, complemented by information gained from on-site assessments, to more detailed risk maps or even definitive compliance maps.

In order to **ensure environmentally responsible land use planning**, we recommend that the following principles should be followed by map developers (Section 4.1):

- Application of the precautionary principle, which is a basic requirement for EU environmental policy, an important aspect of it being that the proponent of an activity should bear the burden of proof with regard to resolving uncertainty over possible impacts.
- Assessments need to be based on data that are fit for their purpose (Section 4.3).
- Adherence to the ecosystem approach, which most importantly for this study calls for a participatory process involving all key stakeholders, with decisions made at the lowest appropriate level.
- Definitive compliance maps require endorsement from competent environmental authorities, as it is very difficult for external organisations such as the European Commission to independently conduct such assessments.

- Environmental information and decisions made on the acceptability of biofuel production need to be transparent and open to public scrutiny.

As part of this process, we recommend the following **criteria to establish whether maps are fit for purpose** (Section 4.3), reflecting eight general considerations (presented without any indication of order or importance):

- Scope and definitions: the different definitions of land related sustainability criteria, such as those of the RED, have been considered and mapped in accordance with the Directive.
- Data sources and description: meta-data are provided to understand the different data sources on which maps are developed and their suitability.
- Process and methodology: the methodological approach used to process and combine data and produce the final map(s) is clearly described.
- Data resolution: this is adequate to determine whether land related sustainability criteria can be reliably assessed from the map.
- Time period covered: cut-off dates, eg as set out in the RED, are adhered to, and the most up to date data are used in the assessment of land related sustainability criteria.
- Area covered by the map: the maps show the total area of land affected by the proposed scheme and any incidental impacts outside the area of cultivation.
- Data validation and accuracy: data are validated and cross checked during the production of the map.
- Official endorsement: the map is endorsed by the relevant responsible environmental authority, in consultation with appropriate environmental data holders and other environmental stakeholders.

Voluntary certification schemes that can be used by biofuel producers and other economic operators to demonstrate compliance with the RED sustainability criteria could decide to use maps as part of the compliance process. Such maps would be submitted for recognition to the European Commission. The assessment by the Commission would depend on the purpose of the maps, eg indicative versus definitive compliance maps; a rigorous step wise assessment procedure for the latter type is recommended that would involve environmental authorities in biofuel producing countries (Section 5).

Robust maps developed in line with the recommended principles and criteria may be a way to mitigate indirect land use change (ILUC) from biofuel production (Section 6). This is only the case, however, when such maps are applied to the wider agricultural sector and developed in a sufficient number of countries. For land use planning to indeed become a powerful tool, several hurdles need to be overcome, related to governance structures in the land use sector, the practical challenges of land zoning and sufficient monitoring and surveillance to enforce land zoning decisions.

1 INTRODUCTION

1.1 Context of the work

The EU Renewable Energy Directive (RED)[1] has established ambitious targets for the use of renewable energy in the EU Member States. In the particular context of transport, it has introduced a binding target of 10 per cent renewable energy use in transport to be met in each Member State by the year 2020. According to analyses of the National Renewable Energy Action Plans (NREAPs) that Member States had to submit to the Commission by June 2010, first-generation biofuels, for which feedstocks are often grown in competition with food and feed crop production, will make up 90 per cent of the volume needed to meet this target. Bioenergy sources overall are anticipated to contribute around half to meeting the RED's overall 20 per cent renewable energy share to be reached by the EU in 2020[2].

In order to deal with the environmental sustainability challenges of growing crops for biofuel and bioliquids production, the RED includes a sustainability scheme (see section 2) setting out requirements in relation to GHG savings and areas valued for their biodiversity and carbon stocks. The European Commission (in particular DG ENER, responsible for the file together with DG CLIMA) is still in the process of operationalizing elements of the biofuel sustainability criteria.

To deliver effective regulation it is not sufficient simply to set out the criteria to be met; mechanisms for implementation, enforcement and verification of compliance also are necessary (Bowyer *et al*, 2010). Article 18 of the RED specifies the mechanisms for verifying the compliance of biofuels placed on the EU market by economic operators with the sustainability criteria (that are set out in Article 17).

For biofuels to count towards the RED targets or be eligible for financial support, economic operators must demonstrate to the relevant Member State that the RED's sustainability criteria are being complied with. Under the Directive, Member States are required to adopt measures to ensure economic operators submit reliable information on compliance. Member States may also request the data used to develop this information or proof. The information provided by the economic operator must have been independently audited, prior to submission to the Member State, to ensure evidence is accurate, reliable and protected against fraud.

To assist economic operators in developing an evidence base and demonstrating compliance, Article 18 specifies several ways in which compliance can be proven, which are further elaborated in the next section, one of them being through the use of national or international voluntary certification schemes that set standards for biomass production and are recognised by the European Commission to meet adequate standards of reliability,

[1] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF

[2] These figures are taken from Beurskens *et al* (2011).

transparency and independent auditing. A first batch of seven certification schemes under which economic operators may seek recognition as a way to demonstrate compliance with the RED's sustainability criteria for biofuels and bioliquids were approved by the Commission in July 2011. Further schemes have been recognised since then and this process continues. The schemes constitute an important step in making the sustainability scheme operational. At the time of writing, the Commission is still expected to clarify some of the standards that need to be met with respect to the biodiversity criteria (ie in relation to highly biodiverse grasslands one of the principal habitat types on which feedstocks should not be grown if they are to comply with the Directive).

According to a communication by the Commission (2010/C 160/01), it is envisaged under the RED that certification schemes ('voluntary schemes') may use geographical maps as the basis for demonstrating compliance with the RED criteria[3]. This could result in reliance on strategic land use planning approaches whereby maps may:

- Provide positive guidance for biofuel producers on appropriate (in the sense of the RED) biofuel raw material cultivation areas;
- Trigger national land use planning processes protecting sites beyond the biofuel sector (long-term goal), which would help to avoid wider indirect land use change (ILUC) impacts.

There are a range of approaches to land use planning (see for example GIZ, 2011) and maps could contribute to them in a variety of ways. However, in this study we recognise and focus on the following potentially overlapping and interacting land use planning elements as follows:

1) **Definitive compliance maps** that aim to reliably and definitively identify and delineate areas that are compliant with RED criteria (or other land use sustainability criteria) and are hence suitable in this respect for biofuel feedstock cultivation. Such maps are sometimes called 'go / no-go' maps. For example, with respect to RED criteria, no-go areas would include protected areas, primary forest and other forested land, biodiverse grasslands, wetlands and peatlands. However, the mapping of 'go' areas is potentially misleading because it could be interpreted as a recommendation that biofuels should be grown in an area, whereas in fact it only refers to compliance with a limited set of environmental criteria. Therefore, to avoid such misunderstandings, we now recommend that definitive compliance maps should not refer to 'go areas' unless the maps are based on a comprehensive assessment of all relevant considerations, including social as well as environmental issues.

2) **Indicative guidance maps** that provide information to biofuel producers, authorities and other interested parties on which areas of land should probably be avoided to ensure compliance with sustainability criteria, and which may be worth

[3] See also section 5.1. The relevant quote from Communication 2010/C 160/01: '"Non- typical" schemes may have different forms such as maps showing that certain geographical areas are compliant or not compliant with the criteria…'.

investigating further as potential sites for biofuel feedstock cultivation. Such maps do NOT aim to demonstrate compliance with the RED land related criteria or other voluntary sustainability criteria *per se*.

3) **On-site assessments**, where maps and other data are unavailable or incomplete, or to check for the presence of high biodiversity habitats that are difficult to identify from remote sensing and other central data sources (eg highly biodiverse grasslands that should be protected under the RED).

There are of course other potential variations on the above framework and types of approach. For example risk maps might indicate areas in which the production of biofuel feedstocks would definitely not be compliant with sustainability criteria (ie are 'no-go areas'), areas that are of medium risk of contravening criteria (and might require a site survey to assess their suitability) and areas that are of low risk and probably the best areas to further investigate. Furthermore, as discussed later in section 0 it is logical to use the approaches in combination. However, for the purposes of this report we refer to the three distinct approaches above.

There is an opportunity to support the work of the Commission and the establishment of sustainability schemes that would help to ensure that the biodiversity criteria (and other environmental criteria) are fully complied with through the implementation of robust and transparent procedures that involve all appropriate stakeholders and use the best available up-to-date data.

There are currently a number of initiatives underway that are studying options or attempting to operationalize the sustainability criteria in practice; these are reviewed in section 2. One initiative to develop risk maps is the WWF Germany led *SuLu* (**Su**stainable **L**and **U**se) land use mapping project that is being developed by WWF in collaboration with partners (governmental and non-governmental) in Indonesia, Brazil and Colombia[4]. One of the potential outcomes of the project is to have the maps, which could classify areas into EU RED no-go as well as high-, medium- and low-risk areas[5] (which are not covered by the EU RED), used by voluntary schemes or biofuels producers as evidence towards demonstrating RED compliance.

Many initiatives are drawing on lists and maps of protected areas and various assessments of the biodiversity conservation of potential production areas (irrespective of their protection status). But this in itself is not straightforward as a variety of approaches, indicators, criteria and standards have been used by different institutions to evaluate and identify areas that are considered to be of high priority for biodiversity conservation (see Annex 2). There are also differing definitions of protected areas even in the same apparent category and often incomplete and non-standardised inventories (see Annex 1). It is therefore important to ensure that biofuel suitability maps use appropriate definitions of

[4] 'Global Land Use and Sustainable Biomass Production' project: http://www.globallandusechange.org/.

[5] The SuLu project is ongoing and will be subject to changes, the final definition and naming of categories is in progress with national stakeholders.

protected areas and maps of protected area boundaries that are recognised by national competent (ie responsible) environmental authorities.

The RED sustainability criteria under Article 17 3(b)(ii) aim to protect sites that are listed 'by intergovernmental organisations or the International Union for the Conservation of Nature'. Therefore, Ramsar Sites, Biosphere Reserves and World Heritage Sites for example should all clearly be 'no-go areas'. Although IUCN has developed criteria for defining protected areas and a typology for protected areas (Dudley, 2008) they have not directly identified sites themselves. Therefore the IUCN component of Article 17(3)(b)(ii) is in practice non-operational at the moment. However, IUCN and others are currently developing the Key Biodiversity Area (KBA) concept (see Annex 2) and may in future endorse lists of KBAs. IUCN listed KBAs presumably would then be protected under the RED (subject to recognition by the European Commission).

One particular challenge relates to the operationalisation of the sustainability criteria for highly biodiverse grasslands (which have still to be defined further by the Commission under the Comitology Procedure). Recent studies have suggested that the mapping of natural grasslands should be feasible (White *et al*, 2000), but defining and mapping other highly biodiverse grasslands will be very difficult. It is likely that some form of evaluation framework that combines the approaches listed above will therefore be necessary (see Annex 4 for the summary of an approach proposed by IEEP).

Given the variety of approaches and datasets that are being used (and their limitations) it is particularly important to consider how maps or on-site assessments of RED compatibility could be used by biofuel producers and within-country environmental authorities, and how they would be assessed by the Commission.

1.2 Aims of this study

The overall objective of this project is to support the *SuLu* project by developing a reliable methodology for the mapping of appropriate land uses that is likely to be compatible with RED requirements, and to assess the relative merit of land use mapping for reducing indirect land use change impacts[6].

This overall objective can be broken down into three tasks that also determine the structure of this report:

1) ***Identification of principles and criteria*** that land use planning maps need to adhere to so as to be deemed reliable and effective in protecting areas of high value for biodiversity and ecosystem services as well as for carbon stocks. This includes a review of the mapping within the SuLu project as well as a review of the methodology work that has been undertaken in the SuLu project; as well as a review of other ongoing mapping processes and other tools to identify areas of conservation interest.

[6] The findings of a draft version of the report provided a background for a *Knowledge Café* organised by IEEP at the IUCN World Congress in Korea in September 2012. The event was designed to identify lessons learnt from initiatives that aim to use land use mapping and certification schemes to limit direct and indirect biodiversity and ecosystem service impacts from the production of biofuels, biomass and other agricultural commodities.

2) Consideration of potential ways of integrating land use planning maps and on-site assessments in the ***political process***, eg in order to demonstrate compliance with the RED land use criteria. This focuses on the use of maps in an EU policy context and also considers whether and how maps could be recognised by the European Commission.
3) Critical review of different ***approaches to mitigate ILUC*** with a focus on land use planning and the relative merits and shortcomings of this approach to mitigating ILUC.

Whilst the work under the first task has reviewed existing mapping initiatives, technical assessments of statistical, GIS and remote sensing methods used within different initiatives are not within the scope of the study. Instead the key aim is to draw on the experiences gained from existing initiatives to identify generally applicable principles and criteria that can provide guidance to future mapping activities as well as to policy makers assessing the quality of maps. This work is set within the context of providing biomass for sustainable biofuels. However, the resulting principles and methodology can be extended to other commodities, so as to demonstrate for example aspects of the sustainability of food and feed crops.

2 THE RED SUSTAINABILITY REQUIREMENTS AND THEIR IMPLEMENTATION

In order to ensure the sustainability of biofuels used to meet the 2020 10 per cent renewable energy in transport target under the RED as well as the 6 per cent reduction target for the lifecycle emissions of transport fuels spelled out in the Fuel Quality Directive (FQD)[7], both directives contain sustainability criteria (see

Box 1: Overview mandatory sustainability criteria of the RED and FQD

). This section briefly introduces the criteria as well as the different ways in which economic operators in the biofuel supply chain can demonstrate compliance with the RED's sustainability criteria.

Box 1: Overview mandatory sustainability criteria of the RED and FQD

The RED's mandatory sustainability scheme consists of three main building blocks of criteria that need to be adhered to in order to biofuels and bioliquids to be counted for the national renewable energy targets and to be eligible for financial support (RED Article 17(1)). These three elements are:

- A **minimum GHG saving requirement** (Art 17(2)). This is specified to be of at least 35 per cent. It will increase to 50 per cent from 2017 onwards and to 60% for new installations from 2018;
- **Land requirements** to prevent the use of raw material from land that was previously:
  - of high biodiversity value (Art 17(3));
  - high carbon stock (Art 17(4));
  - peatland, *unless evidence is provided that the cultivation and harvesting of that raw material does not involve drainage of previously undrained soil* (Art 17(5));
- Sustainable biofuels must be traceable via a chain of custody based on a **mass balance** methodology (Art 18(1)).

[7] Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 of 23 April 2009amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions, http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0088:0113:EN:PDF.

Article 17(3) states that biofuels and bioliquids *shall not be made from raw material obtained from land with* ***high biodiversity value***. It then goes on to qualify this statement by clarifying that for the purposes of the Directive this means land *that had one of the following statuses in or after January 2008, whether or not the land continues to have that status*:

a) *Primary forest and other wooded land*

b) *Areas designated* for nature protection

c) *Highly biodiverse grasslands that is:*

(i) natural, namely grassland that would remain grassland in the absence of human intervention and which maintains the natural species composition and ecological characteristics and processes; or

(ii) non-natural, namely grassland that would cease to be grassland in the absence of human intervention and which is species-rich and not degraded, unless evidence is provided that the harvesting of the raw material is necessary to preserve its grassland status.

With regard to the specific provisions for **high carbon stock land**, Article 17(4) defines those as *land that had one of the following statuses in January 2008 and no longer has that status:*

(a) wetlands, namely land that is covered with or saturated by water permanently or for a significant part of the year;

(b) continuously forested areas, namely land spanning more than one hectare with trees higher than five metres and a canopy cover of more than 30 %, or trees able to reach those thresholds in situ;

(c) *land spanning more than one hectare with trees higher than five metres and a canopy cover of between 10 % and 30 %, or trees able to reach those thresholds in situ, unless evidence is provided that the carbon stock of the area before and after conversion is such that, when the methodology laid down in part C of Annex V is applied, the conditions laid down in paragraph 2 of this Article would be fulfilled.*

The RED provides for different mechanisms of proving compliance with the sustainability criteria. These mechanisms are laid out in Article 18 of the RED and are further specified in a Communication on 'voluntary schemes and default values'[8]. They include:

- National systems of ensuring compliance with the sustainability criteria whereby economic operators directly submit information to Member State authorities (Art 18.3);
- European Commission recognised voluntary national or international schemes (Art 18.4);
- Bilateral and multilateral agreements concluded by the European Union with third countries and recognized by the Commission for the purpose of the RED so that biofuel feedstocks grown within that country would be considered to comply with the Directive's requirements (none at present, Art 18.4).

[8] Communication from the Commission on voluntary schemes and default values in the EU biofuels and bioliquids sustainability scheme (2010/C 160/01), http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:160:0001:0007:EN:PDF.

Box 2 below summarises the key actors involved in the processes surrounding the sustainability certification of biofuels. From informal exchanges, discussions and presentations with and by the Commission, it is apparent that the Commission has given considerable attention to the voluntary schemes option. The use of voluntary schemes is explicitly mentioned as a '[tool] designed to reduce the administrative burden for economic operators'[9]. Apart from providing a tool to assess the sustainability of biofuels imported from outside of the EU, the attractiveness of such schemes is that once recognized by the Commission, they must be recognized by all Member States as proof of compliance, hence facilitating intra-EU trade of sustainably produced biofuels as well as helping establish similar standards concerning the verification of sustainability across Member States.

A range of certification schemes has been developed over the last years for the purpose of the RED. At the same time, existing schemes (eg targeted at specific agricultural products and/or markets) have been developed further in order to make them 'RED-compatible'. Voluntary schemes are recognised following a 'comitology' process by which the Commission issues an opinion as to whether or not to recognise a scheme. As part of an 'advisory procedure' the Commission's opinion is referred to a Committee of Member State representatives to issue a (non-binding) opinion.

As of January 2013, the European Commission has officially recognised thirteen schemes following committee meetings of Member State representatives[10]. Section 5 introduces the way by which voluntary schemes may make use of geographical maps and how the EC could go about assessing such maps. The recognised schemes vary in their coverage of different biofuel pathways and geographical coverage. Some for instance only certify the supply chain of a specific biofuel pathway and/or of biofuels coming from certain producer countries. Others apply to all types of biofuels produced in all countries. Schemes may furthermore vary by the extent to which (if at all) they include criteria that go beyond the mandatory criteria of the RED (eg covering social sustainability issues). The approved schemes are:

- ISCC EU – German (government financed) scheme covering all types of biofuels;
- Bonsucro EU – Roundtable initiative for sugarcane based biofuels, focused on Brazil;
- RTRS EU RED – through the Roundtable on responsible soy, focus on Argentina and Brazil;
- RSB EU RED – Roundtable initiative covering all types of biofuels;
- 2BSvs – French industry scheme covering all types of biofuels;
- RSBA – Industry scheme for biofuel producer Abengoa covering their supply chain;
- Greenergy – Industry scheme for Greenergy covering sugar cane ethanol from Brazil);

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[9] See Communication 2010/C 160/01. The same holds for bilateral or multilateral agreements between the EU and third countries. However, no such agreements have been concluded and recognised by the Commission for the purpose of the RED up to this date.

[10] The list of recognised schemes is available at: http://ec.europa.eu/energy/renewables/biofuels/sustainability_schemes_en.htm.

- Ensus – developed by UK bioethanol producer Ensus only covering bioethanol from EU feed wheat produced by Ensus itself;
- Red Tractor Crops and Sugar Beet Scheme – a UK Assured Food Standard derived scheme;
- SQC – Scottish Quality Farm Assured Combinable Crops scheme;
- Red Cert – German origin scheme previously recognised in Germany covering all types of biofuels;
- NTA 8080 – Dutch origin scheme previously recognised in the Netherlands covering all types of biofuels (and developed to also certify solid and gaseous biomass);
- RSPO RED – Roundtable on Sustainable Palm Oil adapted to suit RED requirements.

Box 2: Key actors in the biofuel certification processes

- European Commission – the Commission will be responsible for developing guidance in terms of the permitted actions on the part of Member States and their regulators. Moreover, they will importantly specify which voluntary schemes are deemed in compliance with EU requirements, which would include assessment of maps submitted by voluntary schemes.
- National regulators and competent authorities.
- Voluntary schemes – this broad heading encompasses assurance schemes that have set standards relevant to biofuel and agricultural production. This includes schemes that were developed with the purpose to assess biofuel sustainability in the line with the RED (eg ISCC, REDCert) and schemes that have been around for longer and are adapted to seek recognition under the RED (such as RSPO, Red Tractor).
- Standard setting bodies – these organisations specify detailed standards to be adopted in order to audit or verify compliance
- Certification and verification bodies – these organisations will be providing auditing services either to determine compliance with requirements by producers on the ground or to assess the compliance with standards along the supply chain.
- Industry representatives – important groupings include farmer representatives, product specific support groups for example focusing on the marketing and development of oilseeds or sugar products and fuel producer groups.
- Processing industry – including feedstock marketers, importers, fuel processors, oil seed crushers.
- Feedstock producers – including individual farmers, cooperatives and plantations.
- Civil society – including local communities, environmental and social NGOs and independent experts developing standards and approaches for assessing biofuel sustainability.

3 REVIEW OF MAPPING INITIATIVES

This section summaries the review of approaches to identify areas of high biodiversity (see Annexes 3 and 4) and of existing initiatives that aim to map such areas, and others of relevance to environmental sustainability criteria, to plan and control the cultivation of areas for bioenergy crops in accordance with RED criteria and/or other sustainability criteria defined under the respective initiatives. The information gathered through this review is used to inform the proposed principles and criteria for developing map based approaches to establish suitable cultivation areas for bioenergy crops and the reduction of indirect land use change as a result of bioenergy production.

As mentioned above, the work of this project is rooted within the SuLu project led by WWF Germany and involving WWF partners in the study regions Indonesia and Colombia. The US based WWF Conservation Science Program (CSP) provides scientific oversight and technical expertise on Geographical Information Systems (GIS). IEEP have worked in collaboration with the SuLu project team[11] experts to develop the principles and criteria set out under Section 4 to supplement the information found throughout a review of existing mapping approaches.

Acting through the sustainability criteria of the Renewable Energy Directive, SuLu is identifying the most important areas for the conservation of biodiversity and lands with high carbon stock value. They are working with stakeholders on the development of methods to identify no go (in the sense of breaching the RED sustainability criteria), high-, medium- and low-risk areas for sustainable biomass production. The project uses geographic techniques to define and communicate RED requirements and to integrate advanced landscape analysis into spatial planning with local stakeholders (further details of the work can be found in Annex A4.2).

Ten existing mapping initiatives were identified as relevant to this study and can be broadly grouped as follows:

- Those approaches that use geographic data in order to compile maps by using this data to draw conclusions about carbon stocks and/or biodiversity, but also overlaying existing databases of eg protected areas, so to say top down maps. These include: Local Ecological Footprinting Tool (LEFT), BioCarbon Tracker, Eyes on the Forest, International Biodiversity Assessment Tool (IBAT);
- Those approaches where more thorough assessments are made that go beyond the use of geographical data and include checking against social criteria for instance and where the results of these assessments are then mapped for visualisation. These include: ZAE Cana, Potico;
- Other types of approaches that include objective criteria but do not result in mapped outputs. These include Responsible Cultivation Areas (RCA) and general

[11] The SuLu team's expertise stems from their focus on supporting the development of spatial planning concepts for the Llanos grasslands in Colombia and the eco-regions of Kalimantan and Sumatra in Indonesia in partnership with local stakeholders, including governments, communities and conservation groups. The objective is to avoid greenhouse gas emissions and minimize pressure on land with high biodiversity caused by biomass production.

approaches to identify areas of high biodiversity such as the High Conservation Value (HCV) approach;

- Hybrid approaches, ie the SuLu project as well as the mapping initiative of the Roundtable for Responsible Soy (RTRS) that fall in between the first two categories of this list.

In addition to the overview provided in Annexes 3 and 4, we also draw on another SuLu subproject conducted by meó Consulting (Böttger, 2011), which examined the relative merits of different approaches and tools to identify areas of high biodiversity importance in particular highly biodiverse grasslands. Annex 5 contains a brief summary of this work.

None of the initiatives reviewed here identify a comprehensive set of principles and criteria that can be used to objectively review the robustness of other mapping approaches or as guidance for future map development. Rather they set out sustainability criteria on which to make decisions about schemes/proposals in general. As a result of this lack of existing criteria it has been necessary to establish an objective set of principles and criteria on which to base assessments. These are set out in Section 4.

4 PROPOSED FRAMEWORK AND CRITERIA FOR USING MAPS TO SUPPORT SUSTAINABLE BIOFUEL PRODUCTION AND OTHER LAND USES

The overall aim of this chapter is to develop a proposed framework and criteria for the use of maps in land use planning as a means of ensuring sustainable biofuel production. This chapter therefore firstly identifies a number of key principles that should be taken into account in land use planning and the implementation of RED and similar sustainability requirements. On the basis of these criteria, and experiences from current biofuel related land use mapping and planning initiatives, section 4.2 then considers the advantages and disadvantages of different land use planning and control approaches, namely definitive compliance mapping, indicative guidance mapping and on-site assessments. The identification of key principles and the contribution that each approach can make to supporting sustainable biofuel production then provides the basis for a proposed integrated framework for planning and ensuring compliance with sustainability criteria. This in turn sets the context for the development of more detailed technical criteria for mapping initiatives, in particular those that aim to provide definitive sustainability compliance maps.

This chapter draws on the results of the review of mapping initiatives in Annexes 3 and 4 and the study by meó Consulting (Böttger, 2011) summarised in Annex 5, but also the results of expert workshops held in 2012 in London and the IUCN World Conservation Congress in Korea.

4.1 Principles to guide environmentally responsible land use planning

There a number key broad and widely accepted environmental principles such, as the precautionary principle and ecosystem approach that should be taken into account in all forms of sustainable land use planning. In addition more specific principles have been proposed by others relating to land use mapping that are relevant to biofuels, which include a comprehensive set proposed by GIZ (2011) and principles relating to the operationalization of RED grassland criteria (Bowyer *et al*, 2010). Further principles are also implicitly proposed by IUCN (McCormick *et al*, 2009) and in a review of methods for assessing go/no-go areas by Böttger (2011). These concepts and the results of discussions at the London and IUCN expert workshops suggest that the following principles should be followed in land use mapping initiatives that aim to reduce the environmental impacts of biofuels (and other commodities) and ensure compliance with RED sustainability criteria.

- ***Application of the precautionary principle.*** The use of maps in relation to the implementation of sustainability criteria (such as those of the RED) is challenging and involves many uncertainties and therefore the precautionary principle is of particular relevance. In many countries spatial data on land use and the biodiversity value of ecosystems are incomplete and/or out of date, and of variable reliability. A particular current difficulty concerns the identification of highly biodiverse grassland. Such habitats are very difficult to define and map, and the problem is exacerbated by the current absence of detailed guidance from the

European Commission on the interpretation of the grassland definitions included in the RED.

Therefore, given that biofuel production may give rise to irreversible damage of highly biodiverse grasslands and other habitats it is essential that sustainability schemes adhere to the precautionary principle, ie as defined in an environmental context in Principle 15 of the Rio Declaration, which states that: "*In order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation*". In fact Article 191 of the EU's Lisbon Treaty specifies that EU policy on the environment 'shall be based on the precautionary principle'.

Thus proponents of biofuel sustainability schemes should demonstrate that their proposed schemes and maps can reliably ensure compliance with RED and, where applicable, other sustainability criteria, and where this is not possible due to limited data, then either biofuel production should not go ahead or sufficient data should be obtained by the proponent to provide reasonable certainty of compliance.

Another important aspect of the precautionary principle is that **the proponent of an activity should bear the burden of proof** with regard to resolving uncertainty over possible impacts (Raffensberger and Tickner, 1999). Thus biofuel producers should demonstrate to a reasonable level of certainty that their proposed activities are acceptable with respect to sustainability criteria before they can go ahead: it should not be incumbent on others (eg NGOs) to prove that the activities are not compliant with sustainability criteria, in order to have them revised or stopped. However, to avoid unreasonably onerous demands on producers that could constrain acceptable development, the degree of proof required should be proportionate to the degree of environmental risk. Thus, for example, developers that propose to only grow biofuels on arable land, could provide relatively simple maps of agricultural land use (eg based on aerial photographs) to show compliance with some sustainability criteria. In contrast, a producer that proposes to grow biofuels on grasslands would need to clearly explain their interpretation of the RED grassland criteria and provide detailed information on the biodiversity value of the specific grasslands in question, probably through detailed site-visits. Maps of grasslands that claim to definitively show compliance with RED grassland sustainability criteria would need to have been created by suitability qualified experts and validated by competent environmental authorities.

Ideally the provision of maps as proof of environmental sustainability should be carried out as part of legally required impact assessment and planning decision frameworks, especially where biofuel production is being promoted through national or regional polices or development programmes. Such a framework should firstly require Strategic Environmental Assessment[12] (SEA) (Dalal-Clayton and Sadler, 2005; Therivel, 2004) that ideally also take into account social issues. The aim of these assessments should be to consider broad potential impacts of national or regional polices and programmes promoting the production of biofuels, and possibly other commodities. They also aim to encourage the integration of sustainability objectives at the earliest stage of the decision-making process, and allow, for example, the identification of areas where large-scale biofuel production might be appropriate from social, economic and environmental points of view. Strategic assessments would then be followed by project-level Environmental Impact Assessments (EIA) for large biofuel schemes. Such EIAs should provide environmental authorities with the information they need to decide whether environmental impacts from proposed biofuel production are acceptable and permits / licences for biofuel production should be dependent on an approved EIA.

- ***Assessments need to be based on data that are fit for their purpose***. It is clearly vital that any assessment of compliance with sustainability criteria is based data that match their respective criteria and are sufficiently up to date and reliable (see Section 4.3 below for a more detailed discussion on what 'up to date' and 'reliable' might mean). However, in reality land use mapping initiatives may use existing datasets that have been developed for a range of other purposes. Careful interpretation of such datasets is therefore required. For example, as described in Annex 4, some (biofuel) sustainability initiatives (eg RCA, Potico and RTRS) use High Conservation Value (HCV) areas as their basis for identifying areas of very high biodiversity importance. However, HCV areas are of particularly high importance and do not include some habitats such as grasslands. They therefore comprise a small subset of areas that others consider to be of high biodiversity conservation value, such as KBAs (Annex 2). On the other hand some KBAs contain farmland and other habitats that could potentially be used for biofuel production with acceptable biodiversity impacts. Thus basing no-go areas only on HCVs would result in weak biodiversity protection, whilst strictly basing it on KBA boundaries would be unreasonable without further detailed analysis of land uses within them.

  This issue also highlights the need for data to be sufficiently up to date, and of suitable resolution (eg to identify fields that would be suitable for biofuel productions within otherwise unsuitable areas). Section 0 considers these issues in more detail.

- ***Adherence to the ecosystem approach***[13]. Although not a legal requirement of the RED biofuel producers and voluntary schemes should aim to follow the ecosystem approach which is the main working framework for CBD. The ecosystem approach is participatory and requires a long-term perspective based on a biodiversity-based study area and adaptive management to deal with the dynamic nature of ecosystems, uncertainty and the often unpredictable nature of ecosystem functions, behaviour and responses. Another widely applied principle of

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12 Ie environmental assessments as typically applied to policies, plans and programmes, for further information see http://sea.unu.edu/wiki/index.php/Main_Page.

13 See http://www.cbd.int/ecosystem/ for an introduction to the ecosystem approach, the 'primary framework for action' under the CBD.

the ecosystem approach is that decision making should be taken at the lowest appropriate level.

These principles are also echoed by GIZ (2011) with respect to land use planning. They note the need for subsidiarity, such that 'all functions from planning to decision making, implementation and monitoring are assigned to the lowest appropriate level of government in order to be responsive to the needs of citizens and to ensure effective control from below'. They also recognise the need for integration of bottom-up and top-down aspects of planning and decision making, and the involvement of stakeholders in these.

Therefore, with respect to biofuel sustainability schemes, it is important that indicative, and especially, definitive compliance maps are developed at regional or local levels where this is feasible. It might be appropriate to start their development with higher strategic level national datasets and standards, but these should be refined according to regional/local circumstances and in consultation with regional/local environmental authorities, experts and other stakeholders.

- ***Definitive compliance maps require endorsement from component environmental authorities.*** Although data from maps may appear to be suitable and fit for purpose (see above) it is very difficult for others, especially organisations such as the European Commission outside the country concerned, to deduce with reasonable confidence whether or not the data provided in the map are indeed the best available, most up-to-date and sufficiently reliable to identify areas where the production of biofuels would definitely be compliant with RED sustainability criteria. Such an assessment would require a detailed review of available data in each country and consultations with organisations holding environmental data and other stakeholders. Furthermore, and most importantly, the interpretation of some of the criteria, eg relating to protected area designations and the definition of highly biodiverse grasslands will require national or regional knowledge, because they are context-specific.

  For these reasons the production of land use planning maps should be part of integrated land use planning procedures that are carried out, or overseen, by state institutions with the official mandate for planning. At the very least it is necessary to ensure that definitive compliance maps are endorsed by a national (or lower level) competent environmental authority. Such endorsement should ensure that appropriate definitions and standards are used and that the mapped data are reliable and up to date through national, regional and local validation as necessary.

- ***Environmental information and decision making needs to be open to public scrutiny***. Environmental information used by authorities for decision making should be publically available and the decisions made on the acceptability of biofuel production in specific locations need to be very clear, based on transparent objective criteria and open to public scrutiny.

4.2 The potential contribution of different land use planning approaches to supporting sustainable biofuel production

As briefly discussed in section 0 and apparent from the initiatives reviewed, there are a number of ways that land use maps and surveys can be used to help reduce environmental impacts of biofuels (and other commodities), eg by ensuring compliance with RED sustainability criteria. These form three overlapping and interacting broad approaches, which involve a variety of actors (see Box 2 above) and have various strengths and weaknesses (see Box 3).

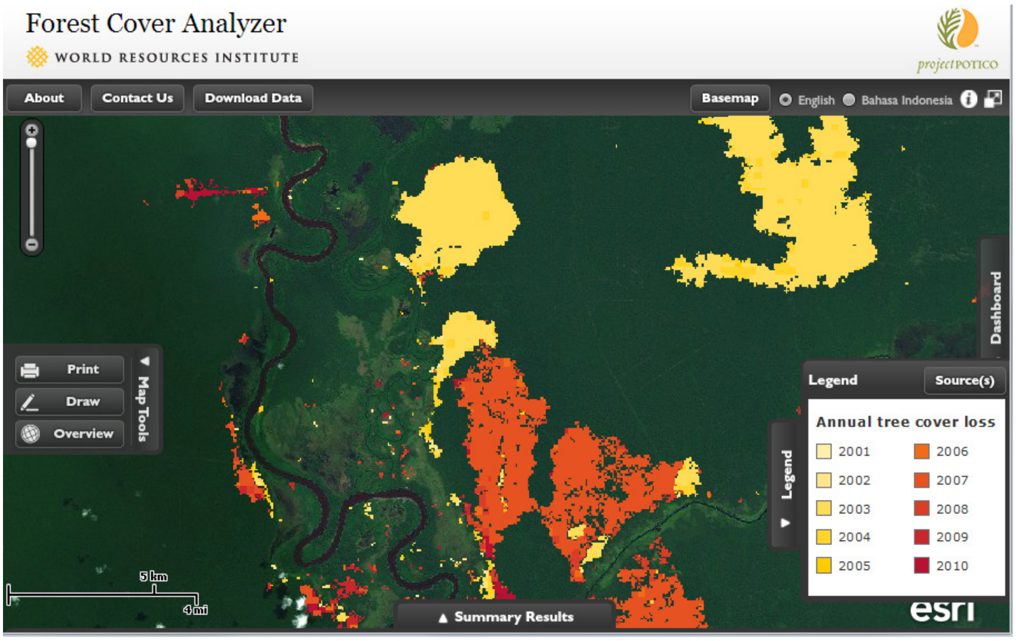
Indicative maps

First, **indicative guidance maps** simply provide information on environmental status and values (eg protected areas, biodiversity values, soil carbon levels, forest cover), without making explicit judgements on the whether biofuels or other commodities should be produced in a specific location. Such information is therefore of most use in the early stages of land use planning. For example, indicative guidance maps could feed into SEA, which would be appropriately initiated by governmental authorities and carried out in collaboration with other stakeholders. The results of the SEA would then enable the identification of broad areas that could be suitable for biofuel production and therefore the focus of additional more detailed studies and mapping. However, there is little evidence that formal SEA or similar strategic planning measures are taken by authorities in the major biofuel producing countries. Nevertheless, indicative guidance maps may help producers themselves to identify broad areas that could be further investigated.

Indicative guidance maps are NOT an acceptable means of directly ensuring compliance with RED or other sustainability criteria. Further analysis is required so that decisions can be made on which areas are and are not compliant – as is carried out in the second approach.

Because of their indicative nature and the expectation that further studies will be conducted, it is appropriate for indicative guidance maps to use broad large-scale data (eg satellite derived maps of forest cover or maps of protected area boundaries). Furthermore although the best available data should be used, these do not need to meet an absolute standard in terms of reliability, resolution and cut off dates. An example of what an indicative compliance map may look like is provided by Figure 1.

Figure 1: Example of an indicative map of forest area loss from the World Resources Institute's Forest Cover Analyzer



Source: http://www.wri.org/applications/maps/forest-cover-analyzer/ (accessed 15 January 2013)

Definitive compliance maps

The second approach includes analysis of detailed mapped information to provide **definitive compliance maps,** (although areas of uncertain status or specified risk status might also be included). The primary purpose of such maps is to ensure compliance with defined sustainability standards such as those of the RED (see further discussion in Section 5) or other voluntary criteria. Such maps could be developed by producers (eg as part of the development of their sustainability schemes to meet RED requirement) or by competent authorities (with funding through, for example, biofuel permit application fees or biofuel production taxes). Because they aim to provide clear evidence of compliance definitive maps need to be of a much higher standard than indicative guidance maps, eg in terms of data reliability and resolution. Thus definitive maps should provide accurate field-scale information, so that suitable areas within otherwise apparently unsuitable areas such as protected areas can be identified. Such maps may also need to conform to certain specific cut-off dates (eg 2008 with respect to the RED).

Land use maps, and especially definitive compliance maps need to be developed with close adherence to the principles outlined in section 0 above, which therefore requires close consultation with stakeholders at national, regional and where necessary local levels, the use of data that are clearly fit for purpose, with new data collected if necessary to ensure this. Where they are produced by biofuel producers or others on their behalf (eg consultants as part of an SEA or EIA) they need to be verified by the national (or lower level) competent environmental authorities. Similarly if the maps are produced by governmental bodies responsible for agriculture or energy production, they would need the endorsement of the component environmental authority.

The requirements for the development of definitive compliance maps are therefore demanding and the process is likely to take a long time. Such maps may therefore be expected to be produced incrementally, eg covering certain easily mappable sustainability criteria first (eg protected areas) and/or by focusing in on certain areas where biofuel production may be most suitable (eg identified by SEA). In practice many areas will, however, remain classified as uncertain or other risk categories. Such areas will therefore require further investigation if biofuel producers wish to propose biofuel production within them, in which case the on-site assessments may be required, in addition to, or to support more detailed mapping.

On-site assessments

The third approach would be to use **on-site assessments** as the basis for a comprehensive simple project-level EIA approach to the accreditation of biofuel production. By itself such an approach would lack strategic assessments of needs and impact avoidance / reduction options, and would therefore be inefficient. However, it could be argued that it would provide a robust approach to ensuring sustainability where combined with indicative guidance mapping (ideally as part of an SEA). A drawback is that on-site assessments are costly. Assessments of some criteria, such as grassland biodiversity, would also need to be carried out by suitably qualified, independent accredited personnel, and in most countries such personnel would need to be trained and intuitions developed to enable this and oversee accreditation. However, the cost of such actions could be borne by producers (if they pay directly for the surveys) with a proportion of biofuel permit or taxation being used to support institutional requirements.

On-site assessments will in any case be necessary where adequate data are lacking for definitive compliance mapping, or where such maps have yet to be developed and approved. Furthermore, on-site assessments will be required in many countries to identify highly biodiverse grasslands as few countries have maps of these habitats that would be fit for the purpose of defining go and no-go areas for grasslands.

If organised as part of a strategic land use sustainability framework then the data collected from on-site assessments could be fed back into databases and mapping initiatives.

Box 3: Strengths and weaknesses of three broad approaches to ensuring compliance with biofuel and other land use sustainability criteria (*continued on next page*)

Indicative guidance maps

Strengths

- Provides a swift response to information needs because data can be provided as soon as available, without additional analysis and consultations needed to identify and agree go/no-go areas.
- Allows more flexibility to make case-by-case decisions.
- Can provide information that feeds into SEA and similar processes that may enable strategic decision making by authorities (eg with respect to license allocations) and producers, such as identifying areas for further detailed investigation mapping and the production of detailed definitive maps (see below).

Weaknesses

- Requires a third party to interpret maps and make a decision on compliance with sustainability criteria.
- Additional decision making requires capacity (building) amongst actors (authorities) making ultimate decisions / assessments.
- Makes it more complex for developers to make decisions on land suitability
- Difficult for external parties (eg European Commission) to assess if sustainability standards have been met, and therefore not suitable by itself for compliance assessment

Definitive maps of 'go' and 'no-go areas'

Strengths

- Provides clear guidance for operators, regulators and other stakeholders that can be used to demonstrate / monitor compliance with sustainability criteria.
- Provides the opportunity for national and international standardisation of equally stringent methodologies and interpretation of sustainability criteria, thereby facilitating comparisons between different countries;
- Can provide strategic control of land uses (eg as an output of an SEA) based on the aggregate consideration of demand for biofuel and other needs (energy, food, feed etc), by, for instance overlaying maps.
- Extension of the approach to other commodities could help extend sustainability criteria to the whole agricultural sector, and thereby help reduce indirect land use change;

Weaknesses

- Comprehensive mapping of go and no-go areas unlikely to be feasible and appropriate as too simplistic.
- Certain dimensions cannot easily be taken into account (especially social issues), which makes justification for labelling of 'go' areas questionable or misleading.
- It is a slow process because it involves analytical and interpretative steps that should be agreed to by competent environmental authorities and other stakeholders.
- Requires data that are fit for purpose, up-to-date and reliable (especially for of go areas), which may constrain geographical coverage and coverage of all sustainability criteria especially biodiverse grasslands.
- Depending on the implementation, it constitutes an inflexible approach.
- Costs can be very large, creating a high burden if maps are created by environmental authorities or NGOs rather than the producers (eg through industry led roundtables);
- Some RED sustainability criteria, eg relating to highly biodiverse grasslands, are difficult to interpret in a standardised way and therefore defining go and no-go areas may be difficult or inappropriate;
- Provides a static map that cannot easily consider changing circumstances and the impacts of land use changes (eg relating to ecosystem fragmentation) without frequent updates.
- Risks disenfranchising local stakeholders as top-down mapping processes often do not involve adequate stakeholder participation.
- May not be politically acceptable if based on criteria that are by parties perceived as outsiders, such as under the RED, and may be considered to be a barrier to trade, ensuing WTO disputes.

On-site assessments

Strengths

- Likely to be provide more reliable, detailed and fine-scale assessment than those based on remote census data, IF carried out by appropriately qualified / trained personnel.
- Enables assessment of criteria that cannot be easily carried out using maps, such as highly biodiverse grasslands.
- Can contribute to the building up of comprehensive, detailed and ground-truthed databases to validate, update and fill gaps in map based approaches.
- Can be easily integrated with local stakeholder consultations etc.
- Creates local employment opportunities (assessors / certifiers).
- Self-assessments by producers reduce economic and administrative burdens on authorities.

Weaknesses

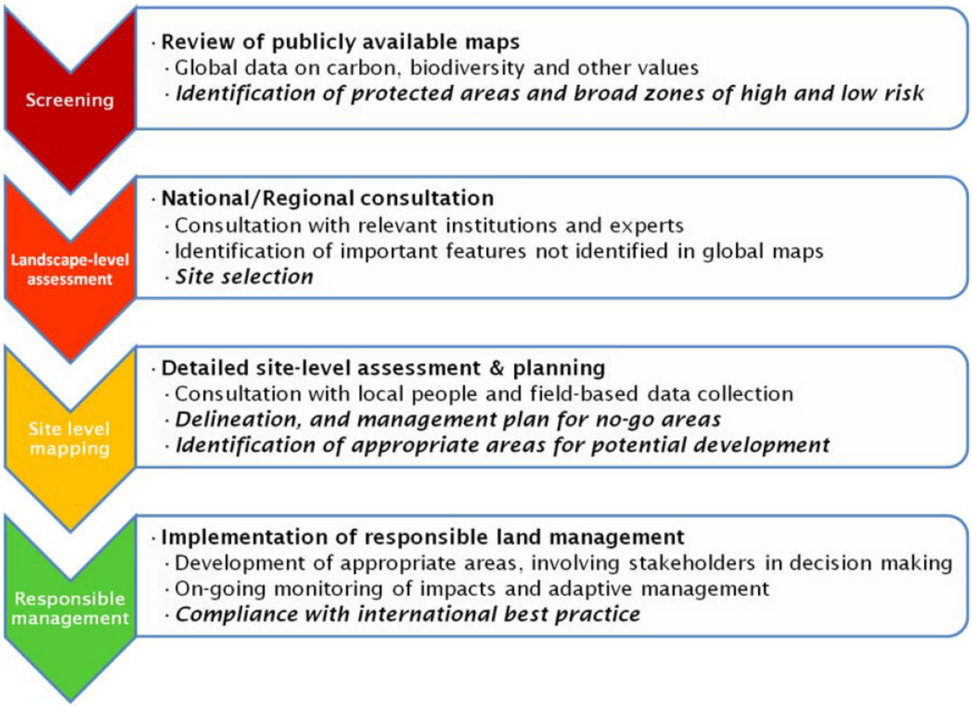
- Wider strategic ecosystem / landscape-level issues are not captured, rendering it difficult if not impossible to protect coherent / non-fragmented habitats, entire watersheds or landscapes.
- Expertise to carry assessments is not always available, and therefore training for surveys and certification is required (especially for certain criteria); which may increase costs.
- Comparatively costly, especially if there would a requirement for surveys of all or many areas.
- Prohibitive costs for small-holders (although collective assessments could help overcome this)
- It may be difficult to maintain consistent and appropriate standards amongst countries / regions due to vary interpretations of sustainability criteria, thresholds and definitions and potential reliance on some form of subjective judgements

It is clear from this review that in practice the three approaches outlined above tend to overlap and interact, and each has potential roles to play in helping to plan and monitor compliance with land use sustainability criteria. Most obviously indicative maps can be compiled using the best available large scale-data to provide an initial indication of suitable areas that are then mapped in more detail according to strict data requirements, supported by site level assessments where necessary. This accords with previous proposals from IUCN for a framework that recognises that data requirements change as planning moves from a global to a local scale (Figure 2).

However, the IUCN proposals do not make a clear case for the screening at a global level, and in practice the initiatives reviewed in this study start at a national level, both for practical reasons (eg because national data may be better or more up to date) and to facilitate political ownership of the initiate from the onset. The need to use national data from the competent environmental authorities is particularly important issue with respect to the identification of protected areas due to differing international definitions (see Annex 1) and interpretations. Global datasets, such as the World Database of Protected Areas are in practice often out of date compared to national datasets.

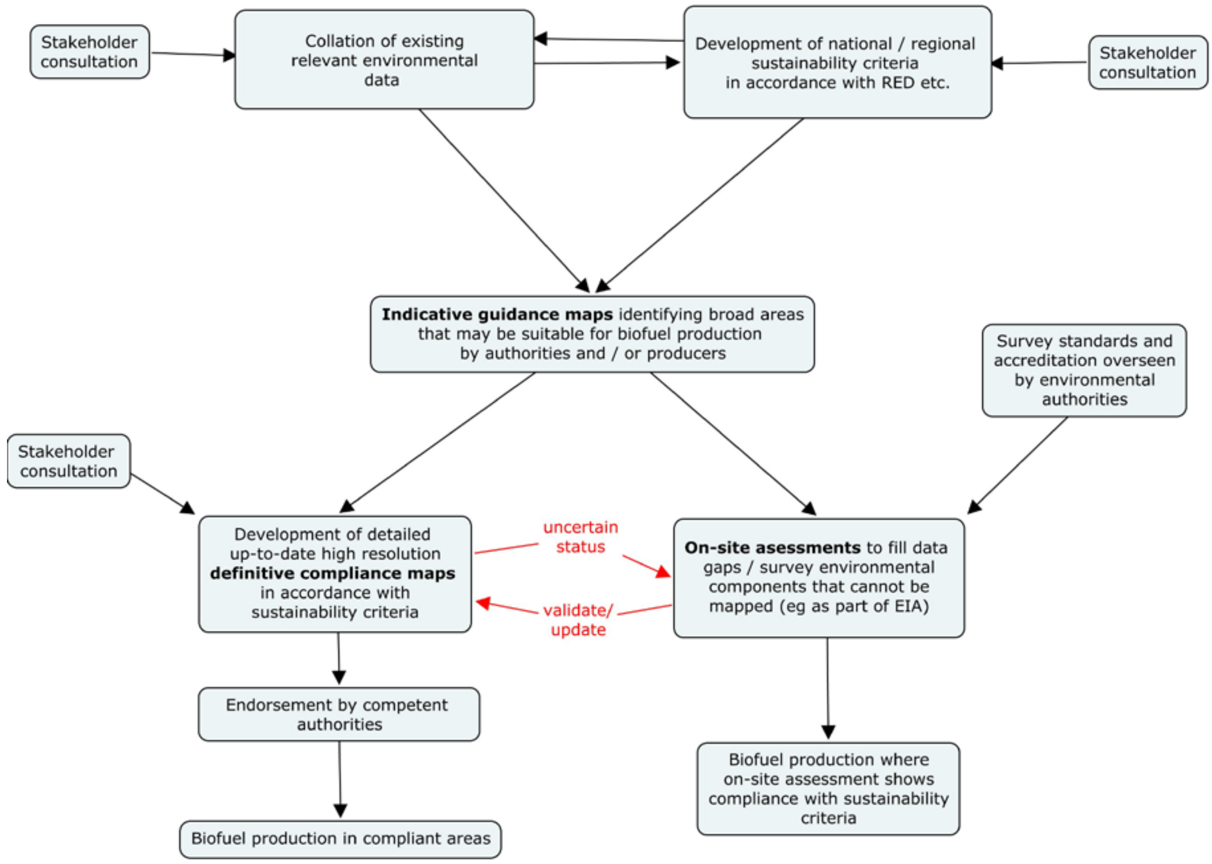
We propose that the three approaches should therefore all be used as part of a multi-level integrated sustainability compliance framework as outlined in Figure 3.

Figure 2: IUCN's proposed common approach for land-use planning



Source: McCormick et al (2009)

Figure 3: A proposed land use planning and control framework for ensuring compliance with environmental sustainability criteria for biofuels



As shown in Figure 3, it seems appropriate to firstly work with stakeholders and environmental data holders to **collate relevant environmental information** as it becomes available. Such information can then immediately help steer biofuel production away from the most obviously environmentally sensitive and important areas. At the same time, international sustainability criteria such as those of the RED will need to be **interpreted in relation to national and regional circumstances**. For example, decisions will need to be made on what constitutes highly biodiverse grasslands and how these can be identified. Such criteria should be developed in consultation with appropriate experts and other stakeholders and be approved by the appropriate competent environmental authority. Analysis of the **indicative guidance maps** in relation to the criteria can then identify broad areas that appear to be suitable or unsuitable to varying degrees for biofuel production in relation to the sustainability criteria.

To further support environmentally sustainable land use planning it is then appropriate to develop **definitive compliance maps** that clearly and accurately indicate where biofuels definitely can and cannot be produced in accordance with the agreed environmental sustainability criteria. Because sustainability decisions may be based on such definitive maps, they need to meet certain quality standards to ensure that they are fit for purpose (as discussed further in section 0 below). Due to such demands definitive maps may in practice need to be produced incrementally, eg covering certain easily mappable and definable criteria first (eg protected areas if accurate boundary maps are available). Where significant new data collection or analysis is required then it may be appropriate to focus on selected regions that appear from the indicative mapping to be most suitable from biofuel production.

However, it is important to realise that definitive maps are unlikely to be able to provide a comprehensive categorisation, and therefore large areas will need to be mapped as being in some form of uncertain status, perhaps with some indication of possible environmental risk (eg taken from the broad inactive mapping). Indeed definitively mapped areas that show compliance with all sustainability criteria may be relatively scarce, and in some areas may only relate to areas that are already in intensive agricultural production. If producers then wish to consider biofuel production in areas with uncertain status then further assessments would be necessary, such as through an **on-site assessment**. On-site assessments will also be necessary in many cases to verify / refine the mapped data (eg to ensure land use changes have not occurred and to refine boundaries) and resolve uncertainty over environmental sustainability criteria that cannot be easily mapped, such as the biodiversity value of grasslands. Where on-site assessments are carried out then the collated data may then be used to validate and update the definitive compliance maps, as shown by the circular arrows in Figure 3.

As discussed above, an important principle is that the burden of proof for ensuring compliance with environmental sustainability criteria should be on the biofuel producer. Therefore in the framework outlined in Figure 3 it is appropriate for producers (or others acting on their behalf) to develop the maps, or for a governmental authority / agency to do this, such as those involved in agriculture, land use planning or the environment. However, all stakeholders should be involved in the process from an early stage, with local stakeholders increasingly involved as fine-scale definitive mapping is undertaken. Also to ensure that environmental standards are complied with then the competent environmental authority (or an independent body appointed by the authority) should be responsible for firstly interpreting relevant international sustainability criteria (eg RED criteria) and then setting national sustainability standards that are consistent with them (eg on the definition of highly biodiverse grasslands). Secondly, they should have the ultimate responsibility for approving definitive compliance maps and ensuring appropriate standards are met in on-site assessments (eg by an accreditation process for surveyors).

Finally, another key principle that should be strictly adhered to is that the process outlined in Figure 3should be implemented in a fully transparent manner, with all stages and outcomes open to public scrutiny.

4.3 Criteria for establishing if maps are fit for purpose

From the different initiatives that have been reviewed as part of this study, maps and mapping methodologies are commonly used in both the identification of areas that are suitable or not for proposed developments as well as in assessments of the potential impacts of such developments. In assessing the suitability of such initiatives it is therefore necessary to provide criteria on which to assess the validity and accuracy of the different mapping approaches used.

Many existing initiatives include a mapping component, some include detailed ethodologies but none[14] provide a stepwise justification of how the mapping criteria or principles have been applied and as a result how this can be used to justify areas suitable for cultivation. As such it has been necessary to set out a series of objective criteria on which the accuracy and suitability of such maps can be assessed and their reliability for the different initiatives proposed.

Eight general considerations are proposed as follows:

- **Scope and definitions**
- **Data sources and description**
- **Process and methodology**
- **Data resolution**
- **Time period covered**
- **Area covered by the map**
- **Data validation and accuracy**
- **Endorsement of mapped outputs**

The criteria are presented equally without any indication of order or importance.

Scope and definitions

The map, as with the overall scheme, needs to demonstrate that the different definitions of land related sustainability criteria of the RED (Articles 17(3) to (5)) have been considered and mapped in accordance with the directive. A detailed description of the definition will be required where alternative definitions are used or where data has been sourced that do not comply directly with those set out in the regulation (for example because of different land cover classifications in the spatial data).

As further discussed under criterion *'Time period covered by the map'* below, the maps must take into account the cut-off date of 1 January 2008 as stipulated in the RED.

Particular care will need to be taken in relation to Article 17(3)c on highly biodiverse grasslands where the Commission are yet to make clear the criteria and geographical ranges of such habitats referred to in the regulation. A precautionary approach should therefore be taken in this respect (see section 4.1 above) such that maps label all grassland areas, with the exception of temporary grasslands that are part of arable rotations (typically less than five years old) as 'no go' areas until the EC has put forward a definition.

[14] Of the reviewed initiatives

Data sources and description

Meta data[15] are crucial to understanding the different data sources on which maps are developed and thus as a tool to assess their suitability. Each map should include either a series of meta-data statements to provide this level of detail, or the maps should be supported by a detailed description of the data used and methodological processes followed. These descriptions should be provided using common terminology in relation to the data provided.

In some cases this information may not have been provided but with reasonable justification. For example the map is based on existing map based products which have clear and detailed methodologies which can be assessed. Ideally a link to these methodologies should be included. In some cases secondary maps (ie maps which have been produced for a different purpose) may be used as a data source (eg for mapping protected areas). In such cases particular care should be taken to establish their suitability with respect to compliance with RED criteria, eg taking into account the original purpose of the map and the data sources that were used in its production.

Process and methodology

The production of many maps can often rely on the processing of raw data (for example survey information or image capture) and the combination of different types or layers of data and information (for example land cover, protected areas, infrastructure, climate suitability etc). The way in which this information is interpreted and brought together can significantly alter the mapped output. As such the methodological approach should be clearly identified along with any assumptions that have been made throughout the process so that the accuracy of the mapping process can be assessed.

The detail and content of this methodology will differ depending on the type of map, if it is derived from remote sensing data, uses existing data and maps, or is based on ground survey information. The processes used should be described using common terminology (Lillesand *et al*, 2007) to avoid ambiguity in descriptions and interpretation.

If this information has not been provided, there should be a reasonable justification. Maps may be based on existing map based products that have clear and detailed methodologies which can be assessed. Where maps are based on existing map products information should be provided on how these maps were produced either with the inclusion of this methodology or links provided to the appropriate reports.

[15] Meta data used in this context describes the characteristics and criteria of the data used in the mapping process. Meta data can include information such as the production date, resolution, source and author as well as the method of production (eg Remote Sensing or ground survey) or how the data were manipulated after collection.

Data resolution

The data underlying the maps can only be judged sufficient to delineate compliance with sustainability criteria if they can identify areas protected from cultivation under the RED that span only small ranges of land or are highly fragmented.

The specific resolution of the data required will depend on the particular criteria considered. In general terms the higher the resolution of the data the more detailed the interpretation can be. Where the map covers areas of small patches of habitat it may be necessary for a finer scaled resolution in order to map the difference between patches. Where the different land covers are large contiguous blocks the data resolution could be coarser.

It is accepted that greater resolution can be expensive, not always available for all areas or time periods[16] and in certain cases not necessary. Examples of maximum[17] resolution ranges are given in relation to specific sustainability criteria in Table 1. The justification of the data used should be explicit with particular attention given to how this may impact on the accuracy of the information the map intends to convey.

Table 1: Example maximum data resolution ranges for different sustainability criteria

<table>
<tr><th>Sustainability criteria and associated article number</th><th>Remote sensing or Raster data* (pixel resolution)</th><th>Existing mapped data and information or Vector data* (scale)</th></tr>
<tr><td>Biodiversity – designated areas (Art. 17(3)b)</td><td>-</td><td rowspan="5">1:10,000 – 1:50,000</td></tr>
<tr><td>Biodiversity – highly biodiverse grasslands (Art. 17(3)c)</td><td rowspan="5">50m</td></tr>
<tr><td>Biodiversity – primary forest and other wooded land (Art. 17(3)a)</td></tr>
<tr><td>High-carbon stocks – wetlands (Art. 17(4)a)</td></tr>
<tr><td>High-carbon stocks – forested areas (Art. 17(4)b and c)</td></tr>
<tr><td>Peatland (Art. 17(5))</td><td>1:100,000 – 1:250,000</td></tr>
</table>

[16] The two main sources or satellite remote sensing data that provide global coverage are the Landsat 5TM and Landsat 7ETM satellites operated by NASA and the USGS. Both satellites cover the time period considered by the RED, however Landsat 7 has a higher ground sampling interval allowing greater image resolution. Further information on the Landsat programme can be found on the USGS website at http://landsat7.usgs.gov/index.php or more information on remote sensing information can be found in Lillesand, Kiefer & Chipman (2007).

[17] No minimum resolution figures are provided as the finer the resolution of the data the greater the detail provided.

** Raster data is comprised of individual data pixels that when combined together produce an image such as a digital photograph. Vector data is composed of points, lines and polygons, which are used to represent different features, such as seen on a road atlas*

The specific resolution or scale of the map data required will depend on the particular criteria considered both in respect of the data source (raster or vector) and in the size or extent of the features being mapped. Raster data are more likely to be used as a source of information to produce maps of forests and wetlands, as the extent and type of these land covers can be inferred from such data. Vector data are likely to be used where a more thematic assessment is required, for example the delineation of protected areas or the identification of highly biodiverse grassland, both of which may require a range of data to produce a mapped output. There will of course be exceptions. Table 1 provides examples of maximum resolution ranges for both data types in relation to specific sustainability criteria. In order to get an understanding of the sort of data available, Annex 7 includes a list of available satellite data including information on its resolution, sources and applications. sets out some example map scales and data resolutions used for different purposes. Given the subjectivity of data, the examples provided are based on an assessment of how landscape features and land cover have been described in existing maps in order to provide a practical and realistic series of resolutions to use in identifying the suitability of map based information.

Raster data

The resolution of remote sensing data, such as satellite or aerial photographic imagery, is likely to be limited by the source of the data available in the survey year, as well as cost (Table 2). The most commonly available data for 2008 will be between 20 and 50m pixel resolution. It would therefore be impractical to ask for finer scale information, as it would likely exclude many map approaches on this basis alone. 20-50m pixel resolution also allows a reasonable degree of accuracy when differentiating tree canopy crown cover and broad landscape feature identification at the scale we are likely to observe for the mapping approaches. Using resolutions lower than these figures (higher in numeric terms) can begin to realize errors in the classification of land cover types and areas for certain defined classes. However, lower resolution imagery (ie 250m MODIS) may be acceptable where it is used in conjunction with other data types, such as vector maps or ground survey information, to provide validation of the data (see Table 3).

Table 2: Example of Monitoring Satellites

Monitoring Satellite	Spatial Resolution	Approx. Cost
CBERS 2	20m	Free
Landsat TM/ETM+	30m	Free
ENVISAT	150m	Free
MODIS	250 - 500m	Free
SPOT 4	20m	>$2,500 per scene*
QUICKBIRD	2.5 - 15m	>$3,000 per scene

** A scene refers to the image captured by the satellite*

Vector data and existing maps

Due to the structure of vector data and existing maps, the scale of observation and the information required defines the relative accuracy or observable features (see Table 3).

Provided the base information used to produce the maps is accurate, vector maps can be produced at a variety of scales. The scale of the maps and map information required for the land related sustainability criteria depend on the area covered by the scheme and the individual sustainability criteria. It is further important to establish the resolution of data where areas are quoted or boundaries have been drawn, particularly when conversions have been made between data types, for example drawing hard (vector) boundaries from fuzzy (raster) satellite imagery. When making such distinctions an interpretation of the imagery is required and the relative accuracy of such interpretations should be clearly acknowledged (see **process and methodology**).

It may be possible to use images and maps with lower resolution ranges (course data) providing the output maps are cross-checked with known information or more accurate data (see **process and methodology**).

Table 3: Example map scales and data resolutions used for different purposes

	Scale	Resolution±	Map purpose / use	Observable features
Large scale / high resolution	1:10,000	0.25m <10m	Habitat survey, street planning	Individual trees and other natural features, buildings and roads.
	1:25,000 (1:24,000)*		Land feature mapping, engineering, local area planning, and recreational purposes	Topographic variations, small habitat patches, ponds, rivers, roads and groups of buildings
	1:50,000	>10m <100m	Land feature mapping, land use planning and recreational purposes	Topographic variations, larger habitat patches, larger ponds, rivers, roads and groups of buildings
	1:100,000 +	>100m <250m	Regional and national planning, delineation of roads	Major roads, towns and cities, large designated areas, significant topographic features eg mountain ranges
	1:250,000		Road atlas, large scale geological maps	Major roads, towns and cities, large designated areas, significant topographic features eg mountain ranges
Small scale / low resolution	1:650,000	> 250m	National geological maps	Broad geological features, bedrock, mountain range, region or country wide orientation of populated areas

**1:24,000 scale based on imperial units, 1:25,000 based on metric units*
± See Annex 7 for further information

Time period covered by the map

The time periods covered by the map data used are particularly important when assessing compliance with land related sustainability criteria of the RED. The following requirements must be met to ensure compliance:

- First, definitive compliance maps should include data to demonstrate the land proposed for biofuel feedstock production was not on, or before, the cut off date set out in the regulation, in this case 1 January 2008, covered by any of the various land cover types set out under Article 17. Due to availability or quality[18] it may be necessary to use data from before the cut off date so as to ensure accurate mapping.
- Second the map should include the most up to date information, no more than 12 months old, demonstrating that the area proposed for biofuel production is not covered by any of the various land cover types set out under Article 17(3). This is essential because the RED prescribes the exclusion of land for cultivation where that land 'in or *after* 2008' (emphasis added) is described by the criteria set out under Article 17(3).
- Third, irrespective of the land cover on the 1st of January 2008, a map should be provided that shows, at the time of application, the area proposed for biofuel use is not within a protected area (as designated by the competent environmental authority).

Maps used as part of voluntary schemes should include a regular updating process to reflect the most recent information. As soon as new information becomes available that alters the categorisation of the map, this needs to be reflected and come into immediate effect.

Area covered by the map

Maps should provide suitable coverage to allow an assessment of the potential environmental risks posed by biofuel production. The RED is clear in its consideration of the areas for land based sustainability criteria and that these focus on the areas proposed for cultivation. As such the maps proposed should cover the entire area proposed under the voluntary scheme.

It may also be necessary to consider the potential cultivation impacts on certain areas of land in reference to Article 18(4) sub paragraph 2 that fall outside the proposed cultivated area. If this is the case, such as where water catchments or wider ecosystem integrity may be at risk, then the area covered by the map will need to be larger.

Data validation and accuracy

The data used to support the production of maps should be consistent with other map sources and have been verified to give an indication of accuracy. This is particularly true of

[18] For example remote sensing data may have significant cloud cover in the date in question.

remote sensing information, which is likely to form a large part of the underlying data for remote area mapping, where image interpretation is carried out. Although the use of remote sensing data is common such approaches require validation and ground truthing to ensure that the data presented are an accurate and true reflection of features on the ground.

Where possible the following validation steps should be followed to ensure the accuracy of the resultant map.

- Sample based ground truthing should be carried out where maps are based on remote sensing information through satellite imagery or aerial photography.
    - Thematic accuracy (the rate of correct classification) evaluation should use standard remote sensing classification statistical tools such as user/producer error and/or kappa statistics. Confidence intervals should be reported along with the accuracy statistics.
    - Spatial accuracy (positional accuracy) should be assessed and reported using a different ground truth sample set of coordinate data apart from the thematic accuracy assessment.
- Although the underlying data and process used to produce the maps may be appear to be satisfactory it is good practice to compare the final maps to existing, preferably verified, sources of information. Verification could take the form of statistical information detailing areas covered by certain land use or could be other map based products.
- There should be a clear indication that the sustainability process includes a final on-site assessment to verify the mapped information before final permission is given for any land use change for biofuel production.

These steps should be clearly highlighted in the **process and methodological** descriptions and in the meta-data.

Endorsement of mapped outputs

As with the verification of the underlying data the final mapped output also requires verification to establish if the information included in the map is adequate and suitable to assess compliance with RED criteria. This is particularly true where many map layers have been combined or where image interpretation has taken place. Wherever possible maps should be cross-checked with existing information to ensure that the results or information quoted are accurate and reliable. Verification could take the form of statistical information or other map based products with similar objectives.

However, it is very difficult to deduce from a remote location whether or not the data provided in the map are indeed the best available, most up-to-date and sufficiently reliable to be used with reasonable confidence for definitive compliance mapping. Such an assessment would require a detailed review of available data in each country and consultations with organisations holding environmental data and other stakeholders. Furthermore, and most importantly, the interpretation of some of the criteria, eg relating to protected area designations and the definition of highly biodiverse grasslands will require national or regional knowledge, because they are context-specific. For these reasons it is necessary to ensure that the maps produced to the criteria set out above are supported by national or regional validation and endorsement of the map and its underlying data by a competent environmental authority.

Therefore the assessment process should establish if the map has been clearly approved/endorsed by the relevant competent environmental authority, ideally in consultation with appropriate environmental data holders and other environmental stakeholders. If maps have been endorsed by other organisations (eg a biofuel accreditation agency) or individual expert these should also have a clear mandate to do so from the competent environmental authority. If no such official endorsement is clearly provided with the map then the producer should be expected to seek such endorsement, after resolving any issues raised with respect to criteria set out above. It should be clear that endorsement and accuracy assessment are two separate processes. An accuracy assessment can be completed by the same technician creating the data, while endorsement should always remain with the competent authority.

5 THE POTENTIAL ASSESSMENT PROCESS BY THE EUROPEAN COMMISSION

5.1 The role of the Commission in assessing maps and its challenges

Having introduced the RED sustainability scheme in Section 2, this section outlines the way in which land use mapping may enter and be used in the RED context and proposes how an assessment methodology for geographical maps by the European Commission may work.

The Commission Communication (2010/C 160/01) introduces the concept of 'non-typical voluntary schemes' and under this heading mentions the potential for maps to be submitted to the Commission:

> *'Non- typical' schemes may have different forms such as maps showing that certain geographical areas are compliant or not compliant with the criteria, calculation tools for assessment of greenhouse gas savings or regional agricultural greenhouse gas values associated with a particular feedstock. For these schemes, the Commission will determine an appropriate assessment procedure when it receives a request for recognition of such a scheme.*

These provisions are of particular relevance to those initiatives that develop land use planning maps, including the SuLu project, as they explicitly highlight a way in which maps can be used to support policy implementation. Maps may be submitted as part of voluntary schemes and will consequently be assessed and, if deemed appropriate, recognised by the Commission. The quotation above also highlights the need for the Commission to have at its disposal a reliable procedure to conduct such assessments.

Several elements will need to be considered by the Commission:

- Maps may be developed with different underlying purposes. This is to say that while some voluntary schemes could submit maps that are intended to be **definitive compliance maps** with respect to RED (or other sustainability criteria), others may intend to make use of maps that are indicative and guide economic operators to areas to investigate further as potential sites for biofuel feedstock cultivation.
- The different purposes of maps can require different assessment needs. We would assume that where indicative maps are used to only guide economic operators to areas worth further investigation, these maps would be considered a tool rather than a means of demonstrating compliance with the RED criteria. Therefore, the assessment on whether the scheme effectively covers the land related criteria of the RED will be in line with the usual procedure according to which the Commission recognises voluntary schemes (laid out in Communication 2010/C 160/01).
- The assessment of definitive compliance maps requires a detailed assessment procedure and assessors trained in geographical mapping methodologies. This is because the identification of compliant areas goes along with significant challenges

and risks. While wrong labelling of non-compliant areas would not inflict any direct environmental harm, wrongly labelling an area as compliant when it is actually important for biodiversity or carbon stock may lead to (potentially irreversible) environmental harm. Only identifying existing cropland (in January 2008 in line with the RED cut off date) as areas that are RED compliant would be a safer route to take. Other claims such as distinguishing between different categories of grasslands and allocating them to compliant and non-compliant areas accordingly is also problematic. Even 2008 cropland cannot be declared as compliant areas without further checks. This is because RED Article 17(3) refers to land of '*…high biodiversity value, namely land that had one of the following statuses in or after January 2008, whether or not the land continues to have that status*'. This implies that some land that met the Article 17(3) criteria from before 2008 could no longer be compliant, as a result of, for example, subsequent designation as a protected area, or the development of sufficient tree cover for it to have a high carbon status. This requirement is addressed in Section 4.3 above in relation to the time period for maps.

5.2 A potential step-wise approach to assess maps

The following paragraphs describe in very broad terms the steps an assessment of maps by the European Commission may entail[19].

As **step one**, it is vital for the Commission to understand how the voluntary scheme submitting geographical maps for recognition uses these maps in its process of certifying economic operators. This relates to the distinction made above whether maps are intended to either:

- provide indicative guidance to economic operators on which areas to investigate further as potential sites for biofuel feedstock cultivation, or to
- definitively identify and delineate areas that are compliant with RED sustainability criteria for biofuel cultivation.

In the first case, we would assume that the Commission's assessment would follow the standard procedure to assess a voluntary scheme against the land related RED criteria, in which case the map would not be used as evidence of compliance. In the second case, the assessment of maps needs to follow a detailed assessment methodology, leading to step two.

For the assessment under **step two**:

- First, the Commission could follow an assessment procedure based on the technical criteria introduced in section 4.3 establishing whether maps are reliable in mapping the RED land related criteria. As mentioned, these criteria will be adapted to the RED context and the Commission's assessment requirements in the

[19] IEEP is part of a consortium (led by Ecofys) that is conducting more elaborate work on a potential assessment procedure under the Framework Service Contract with the European Commission ENER/C1/438-2010.

context of a separate project for DG ENER. The Commission may wish to consider a mechanism in order to handle potentially reasonable exemptions for situations in which maps are in line with the large majority but not all of the technical criteria. We envisage such exemptions will need to be justified in line with strict requirements, which could involve an approval of exemptions by national or local environmental authorities and/or on-site assessments.

- Second, and given positive assessment under the previous step (a negative outcome of that assessment would imply the map is not accepted as a proof of compliance), the Commission ought to require that their own assessment is validated through the endorsement by a competent environmental authority of the map and its underlying data. Ideally this will be in consultation with national, regional or local stakeholders and allow a better judgement whether the data and processes used to establish the map are indeed the best available and fit for purpose in the geographical context of the map. Only when such official endorsement has been granted should the map be recognised by the Commission as a way of demonstrating compliance with the RED sustainability criteria. There might be exceptions to the need for official validation in line with the principle put forward in section 0 above that the degree of proofs required should be proportionate to the degree of environmental risk.

In **step three** an assessment is made of how the maps are used by voluntary schemes in order to make sure the chain of custody requirements of the RED are respected; that is, it needs to be clearly traceable that biofuel labelled sustainable is indeed produced from feedstock coming from a designated ‘go’ area.

6 MITIGATING ILUC

The aim of the task represented here is to review different approaches to mitigating ILUC with a focus on the ILUC mitigation potential of land use planning. In the last few years, a range of policy options to address ILUC has been proposed and discussed vividly. In October 2012, the Commission finally reacted to these discussions in an official way by presenting a proposal to amend the Renewable Energy Directive and the Fuel Quality Directive in order to address emissions from indirect land use change[20]. The proposal *inter alia* calls for a 5 per cent cap on biofuels from cereals and other starch crops, sugar and oil crops that can be used to count towards the RED's 10 per cent target, proposes enhanced incentives for certain feedstocks attributed a low ILUC risk and aims to raise the GHG saving threshold for new installations. At the same time, various studies have been prepared that assess and compare different approaches to mitigating ILUC. As part of this task, we present an overview of approaches and their assessment based on the literature. We further assess different options according to the likelihood that they will protect biodiversity and high carbon stock land, the main underlying objectives of the SuLu land use mapping project. Finally, we discuss the implementation challenges in land use planning that would need to be taken into account were land use planning to become a practical solution to ILUC.

The case that ILUC effects exist and hence that action is needed has been made in a robust way, even though there remains disagreement on the exact magnitudes of additional land needs and associated emissions. A study for the European Commission by IFPRI suggests that meeting the EU's biofuel needs in 2020 will cause cropland to be extended by between 1.73 and 1.87 million hectares (Laborde, 2011)[21]. Edwards *et al* (2010) provide a detailed comparison of models and the underlying assumptions and drivers that explain differences in outcomes. A multitude of modelling exercises and alternative approaches (most notably so-called causal-descriptive or spreadsheet-based approaches) are reviewed for example by Lange and Delzeit (2012), Fritsche and Wiegmann (2011) and Dehue *et al* (2011).

A 'first best' solution for ILUC commonly and rightly put forward is the protection of all globally high-carbon stock land as well as land of high biodiversity value from conversion for any kind of activity. In theory, this could be achieved for example by having sustainability criteria for all land-using activities so that all land use change becomes direct land use change. This is more easily monitored than indirect change. Given the long-term horizon anticipated for such an option, other options that seem more readily implementable are being discussed.

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[20] Proposal COM(2012) 595 final of 17.10.2012 for a Directive of the European Parliament and of the Council amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

[21] It should be noted that these figures include total land use change, ie both indirect and direct land use change, as models are not able to distinguish between the two. Laborde (2011) provides an extended discussion of this issue (p21) and the impact assessment accompanying the Commission's ILUC proposal COM(2012) 595 final considers modelled estimates of land use change as the best approximation of indirect land use change. The crop specific land use change emission factors calculated by Laborde (2011) therefore cover both indirect and direct LUC. These crop specific factors are referred to as ILUC factors throughout the report in line with the terminology prevailing in the political debate.

6.1 Literature review – Overview and assessment of mitigation options

According to Article 19(6) of the RED, the European Commission was required to report on the indirect land use change effects of bioenergy production on greenhouse gas emissions by 31 December 2010. At the end of that year, it issued a report on 'Indirect land-use change related to biofuels and bioliquids'. The report sets out four potential policy options to respond to ILUC:

1. take no action, while continuing to monitor the ILUC impacts of biofuel production;
2. increase the minimum greenhouse gas saving threshold required for biofuels;
3. introduce additional sustainability requirements on certain categories of biofuels; or
4. attribute a quantity of greenhouse gas emissions to biofuels reflecting the estimated indirect land-use impact (a so-called ILUC factor).

Option 2 forms part of the October 2012 legislative proposal eventually put forward by the Commission. Under the proposal ILUC factors (Option 4) would become part of the reporting by fuel suppliers and Member States but would not form part of the GHG calculation methodology. The relative merits of those and other options have been discussed extensively among various stakeholders. In the following we present a non-exhaustive and indeed very selective list of some of the recent studies and initiatives that contribute to this discussion by presenting and classifying approaches. The review does not include the major studies that quantify ILUC (eg modelling studies such as Laborde (2011) or deterministic approaches such as E4tech (2010)).

Gawel and Ludwig (2011) classify different methods of mitigating ILUC into three categories of approaches, 1) an impact related approach, 2) a product assignment approach and 3) a general governance approach. The first category consists of methods that convert all indirect into direct land use change, such as by having universal sustainability requirements in place prohibiting the land use change for all types of biomass (and its uses) globally or via international agreements to prevent the conversion of high carbon stock land and areas important for biodiversity. The product assignment approach groups together modelling approaches to determine the ILUC impacts of biofuel pathways, the inclusion of both ILUC factors and also bonuses in biofuel LCAs, and a 'risk based approach' of distinguishing between biofuels according to whether the ILUC-causing risk is estimated as high or low (an example being the Responsible Cultivation Area, RCA, approach, see Dehue *et al* (2010)). The third, 'general governance' approach refers to 'lowering pressure' arising from ILUC, ie reducing in scale or abandoning temporarily or permanently the politically supported and mandated use of biomass for energy.

Gawel and Ludwig (2011) put forward an assessment framework based on ten principles[22] with further sub-criteria. The ten principles shed light on either the 'performance' or 'political feasibility' of the ILUC mitigation measures reviewed. 'Universal sustainability

[22] Five of those review performance: effectiveness; efficiency; unambiguousness; robustness; fairness; the remaining five review political feasibility: availability; policy integration; consensus; practicability; transparency.

requirements' and 'international agreements' fare rather well on the performance related, criteria thus are seen as theoretically rather effective in mitigating ILUC. However, several important requirements for political feasibility are not met. Product-assignment methods are dismissed as mal-performing as well as politically infeasible to a large extent. Among the arguments put forward are that model results are subject to too large uncertainties to serve as a basis for policy making; that ILUC factors could be considered trade barriers[23]; and that risk-based approaches or those relying on bonuses struggle with the definition of 'marginal', 'degraded', 'unused' etc land categories and would risk the displacement of extensive forms of cultivation. The authors finally conclude that 'there is no predominant method that performs well, is also practicable, available and finds general societal consensus' (Gawel and Ludwig, 2011, p854). The most favourable option according to their assessment is to 'diminish bioenergy targets and to choose bioenergy pathways with minor land use conflicts (e.g. residues) in order to lower the pressure on land use change processes' (2011, p855).

Dehue *et al* (2011) see three feasible measures to mitigate ILUC and they classify them into global and project-level mitigation measures. The two global mitigation measures are to 'prevent unwanted direct LUC, globally and for all sectors' for example through land use planning, and to 'reduce pressure on land from the agricultural sector as a whole'. These are thought to be rather long-term solutions, not feasible to implement in the short run and furthermore out of the bioenergy sector's sphere of influence (Dehue *et al*, 2011, p53). Dehue *et al* also point out that the second option of reducing pressure by, for example, increasing yields or reducing consumption does not per se lead to the protection of areas important for carbon storage or biodiversity. Finally they opt for the Ecofys, WWF *et al* joint approach of 'practical production models that prevent indirect impacts at a project level' or, in other words, the RCA approach, which is currently being promoted as the Low Indirect Impact Biofuel methodology, described below.

A study by **Ernst & Young (2011)** commissioned by a consortium of, among others, Shell and IUCN promotes the use of GHG emission bonuses to mitigate ILUC by rewarding best practices along the biofuel production chain. Ernst & Young dismiss other options involving penalties, such as raising the GHG saving threshold and imposing ILUC factors, for not stimulating a change in practices to reduce ILUC risk and also creating an uncertain environment for investment in the biofuel sector. Best practices identified in the report include the use of biofuel co-products to substitute for animal feeds, feedstock cultivation on abandoned or degraded land, yield improvements (including through agronomy support especially in developing countries) and the use of wastes and residues for biofuel production. According to the authors, financial incentives are needed to trigger their adoption and these should be in the form of 'carbon credits'. They link their proposal to the already existing emission credit for biofuels from severely degraded and heavily contaminated land contained in the RED (Annex V Part C). The mitigation measures proposed have been previously proposed elsewhere (a range of them can be found in the RCA / LIIB methodologies, for instance) or have been addressed in ILUC modelling studies,

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[23] It should be noted, however, that Gawel and Ludwig assume ILUC factors would be drawn up on a country level. However, the policy debate centres around *feedstock*-specific (or feedstock group specific) ILUC factors, as for example estimated by Laborde (2011), in both cases the trade barrier argument becomes less compelling.

ie co-products. This last point is important to stress: co-product utilisation to substitute for animal feed is taken into account in the IFPRI study (Laborde, 2011) but this does not eliminate ILUC impacts. The way in which co-products have been modelled by Laborde is deemed appropriate by reviews conducted by the ICCT (Malins, 2011) and for the European Biodiesel Board (Delzeit *et al*, 2011).

Malins (2011), apart from reviewing the key drivers of the IFPRI model, assesses different policy options with regard to their potential net emission savings in 2020 compared to a fossil fuel reliant baseline as well as their inherent abatement costs per tonne of CO_2. This is done by taking the ILUC factors for different feedstocks from Laborde as central values and constructing a likelihood distribution around them. Data on price differentials between ethanol and biodiesel versus their fossil fuel equivalents are used to calculate abatement costs given a certain GHG emission savings level of biofuels net of estimated ILUC emissions. The policy option of raising the minimum greenhouse gas savings threshold leads to average carbon savings in 2020 of up to 19 per cent (this is when the threshold is raised to 65 per cent in 2020). The highest savings can be achieved in the presence of ILUC factors and keeping the GHG saving threshold at 50 per cent in 2020 or in the same setting, but with the potential for ILUC mitigation options. Without discussing the results in detail here, Malins' key result regarding abatement costs is that all ILUC policy options lead to 'much lower expected carbon abatement cost than if ILUC is ignored' (2011, p20).

Ecofys, EPFL[24] and WWF International put forward version 0 of the Low Indirect Impact Biofuels (LIIB) methodology in July 20120 (LIIB, 2012). The LIIB is seen as a tool that can be used in combination with policy options or as part of voluntary schemes in order to differentiate between biofuels with a low and high likelihood of causing indirect impacts. In particular, the methodology puts forward four solutions in order to address indirect impacts on a project level which are derived from the RCA work (see Annex 4 and (Dehue *et al*, 2010)), including 1) the use of 'unused' land; 2) the realisation of yield increases; 3) integration of bioenergy and agriculture models, ie integrating cattle and sugarcane ethanol production; and 4) producing biofuels from residues and wastes or 'end-of-life products'. The focus of the report and of the methodology developed so far is on biofuels, but the authors state that with some modifications it could be applied to other bioenergy forms and potentially non-energy biomass uses as well. The LIIB methodology is put forward as an ILUC mitigation measure that can be applied at a project level, stressing that while there are first best solutions to ILUC, especially through the prevention of land use change globally and across all sectors, these are not immediately implementable or yet enforceable. Key to the methodology is to 'produce biofuel feedstock without displacing other provisioning services of the land' or, in the case of wastes and residues, to 'the potential impacts of displacing the end-of-life product stream from its original use to bioenergy' (LIIB, 2012, p41).

The LIIB methodology as well as other ILUC mitigation options have been analysed in a background paper prepared by the Roundtable on Sustainable Biofuels (RSB) for a public consultation in Spring 2012 on introducing ILUC measures as part of the RSB standard (RSB, 2012a)[25]. Potential ILUC mitigation measures to be included in the RSB standard

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[24] Ecole Polytechnique Fédérale de Lausanne, hosting the Roundtable on Sustainable Biofuels (RSB)

[25] As mentioned in Section 2, the RSB is one of the certification schemes recognised by the European Commission under the RED.

would have to meet the following objectives according to the draft paper: they must '(i) effect change by "uplifting" operators with medium or low sustainability practices into better sustainability practices; and (ii) differentiate sustainable from unsustainable operations' (RSB, 2012a, p16). The paper then sets out a list of potential mitigation options[26] for inclusion in the RSB:

- Option 0: Do nothing;
- Option 1: *Optional* add-on LIIB certification of low-risk biofuels;
- Option 2: *Mandatory* criteria (designed along the LIIB methodology) as part of the RSB standard to minimise risk of indirect impacts;
- Option 3: Implement a (project-specific) ILUC factor[27] in lifecycle GHG calculations; two sub-options are suggested: a) with and b) without mitigation possibility;
- Option 4: Regional/National-level assessment of indirect impacts risk (risk assessment);
- Option 5: Establish 'indirect impacts fund' / indirect impacts mitigation outside the project.

The background paper then assesses these options against a list of evaluation parameters. Focusing on the ability of different options to protect high biodiversity and high carbon stock land, only options 2 and 3a achieve a better outcome regarding those impacts due to land use change on high carbon and high biodiversity land. With regard to option 2, the introduction of criteria to minimise the risk of indirect impacts, it is believed that this option 'would reduce the impact of negative indirect impacts' (RSB, 2012a, p23). Option 3a, ie the introduction of an ILUC factor together with best practices for mitigation, could (similarly to option 2) reduce land use change impacts, depending on the best practices adopted.

In July 2012, the RSB Secretariat published a summary of results from the public consultation to which 36 participants[28] submitted responses (RSB, 2012b). The majority of respondents, around three quarters, opted in favour of addressing indirect impacts under the RSB. A majority of those in favour and in particular participants from academia opted for a combination of options 1 and 2 above, ie introducing an optional LIIB certification tool in the short term given its short envisaged implementation period of around six months, while subsequently adopting mandatory criteria to minimise risks from indirect impacts (option 2). Option 3 (ILUC factors) was the next most frequent response, supported in particular by NGOs.

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[26] See pages 17ff in the paper for a detailed description of the options.

[27] It is specified that ILUC factors would be 'feedstock specific' or 'feedstock type specific' and that they 'would be global and based on existing published values; however, such a dataset of globally-applicable ILUC factors does not currently exist' (RSB, 2012a, p3). The background document lists several sources of ILUC calculations including the Laborde (2011).

[28] This included 13 NGOs, 8 Universities/Research institutes, 8 producers/industry organizations, 4 government/intergovernmental institutions and 2 consultants.

6.2 Protecting biodiversity and high carbon stock land?

The overview of previous assessments by different authors presented above makes clear that an important trade off in preferring one ILUC mitigation option over another is its practical and political feasibility versus its effectiveness in mitigating unwanted land use change. Given the main purpose of the mapping under the SuLu project is to protect high carbon areas and areas important for biodiversity, we summarise the analysis of a selected number of ILUC mitigation policy options to assess whether they are effective in achieving this protection while being implementable. We distinguish between three high-level options and three project level options:

High-level options	Project-level options
• Universal sustainability criteria / Prevent unwanted LUC globally and in all sectors • Reduce pressure on agricultural land eg through yield increases, reduced demand (as for example discussed in Dehue *et al*, 2011) • Land use planning	• ILUC factors • Bonuses for best practices (as in Ernst & Young, 2011) • Low Indirect Impact Biofuels (LIIB, 2012)

High-level options:

- *Universal sustainability criteria / Prevent unwanted LUC globally and in all sectors*
  Clearly this option would be a way to mitigate land use change in areas important for carbon stocks and biodiversity. However, this option also suffers from a lack of political and practical feasibility at least in the short-term and it is frequently argued in the literature that this option should be seen as a long-term vision rather than a solution for the ILUC challenge that could be implemented within the timeframe of delivering the RED targets. The route will only prove effective if sustainability criteria designed to prevent the unwanted land use change are indeed almost universal ie extended to all land using sectors globally and monitored effectively. This would require monitoring and data systems not yet in place, set within a much higher level of international co-operation than can be envisaged at present.

- *Land use planning / zoning*
  Planning land use and in particular the zoning of territories to prevent unwanted land use change as one tool in the 'planning spectrum' can be seen as a way of operationalizing the introduction of universal sustainability criteria. An effective and credible zoning system would need to be developed or endorsed by national authorities and be fit for purpose regarding biofuel feedstocks, irrespective of any other purpose it may have. The added value of the land use planning approach in that context would be to provide 'carrots' in the sense of identifying areas that would be suitable for agricultural, agro-forestry etc development in exchange for the 'stick' of preventing or limiting land use change in a range of other territories. The feasibility of

this approach is not straight forward given major differences between countries and cultures in the approach to land use planning and the relatively demanding requirements that would be needed in this case. For example clear and relevant rules and penalties would need to apply within zones if zoning is to be effective on the ground. Areas without an 'owner' would need to be treated appropriately. Some of the major challenges are introduced in the next section. Most importantly, for land use planning to be a policy tool for mitigating ILUC, it would have to be embraced in a sufficient number of countries representing an important share of the global area suitable for agricultural production.

- *Reduce pressure on agricultural land (eg through yield increases, reduced demand)*
  This option is understood as one of reducing or changing practices in the agricultural sector as a whole (ie not only in biofuel crop cultivation) so as to reduce demands on the resource base of fertile agricultural land. Ways to reduce pressure on the area required for production could include, on the supply side, yield increases and on the demand side reduced demand in high-income countries for 'land-intensive' products most notably meat and the shift to vegetarian or meat-reduced diets. As Dehue *et al* (2011) rightly point out this is does not per se lead to the protection of areas important for carbon stocks or biodiversity while arguably freeing up land for other uses, hence potentially reducing pressure.

Project-level options:

- *ILUC factors*
  The introduction of ILUC factors is mostly discussed on a feedstock basis, eg quantities of GHG emissions differentiated by type of biofuel feedstock. These are determined by economic models, or, alternatively, on a crop category basis, eg oilseeds, cereals etc. The main advantage of ILUC factors commonly put forward is that if they can be precisely determined (which is not straightforward given the reliance on models that necessarily make use of a range of underlying assumptions), they reflect the complete lifecyle emissions of biofuels and therefore enable supply or demand to be steered towards those biofuels that actually lead to decarbonisation of the transport sector. On the downside, ILUC factors do not protect high-carbon stock and high-biodiversity land directly and it is not necessarily the case that the pressure to continue the expansion of agricultural land is reduced. While ILUC factors would steer the industry towards using crops with lower ILUC factors for biofuels, it could be expected that as a response higher-ILUC-factor crops are increasingly diverted to supply other sectors. Brazilian sugar cane is an example of a crop that is typically attributed comparatively low ILUC factors. However, expansion of the sugar cane area often is associated with displacing rangeland which subsequently drives deforestation in Amazonia as farmers/herders seek new grazing for cattle, as evidenced by Lapola *et al* (2010).

- *Bonuses for best practices*
  Bonuses for best practices in biofuel feedstock cultivation and production, as promoted by Ernst & Young (2011), for example, do not necessarily protect high carbon and high biodiversity land. This is under the assumption that bonuses are what their name implies, namely voluntary actions that are rewarded and are an alternative

to mandatory requirements. While some of the actions proposed can mitigate LUC impacts of biofuel production eg when residues and wastes are used that have no alternative use, the fact that such practices are voluntary, even if eligible for being rewarded by financial incentives, implies that protection cannot be taken for granted.

- *RCA/ Low Indirect Impact Biofuels (LIIB)*
  The LIIB (formerly RCA) methodology spells out different production models according to which biofuels can be classified zero or low ILUC. In that sense there would be no pressure on high-carbon and high-biodiversity land from biofuel production if the approach were adopted fully and the right practices were selected. The extent to which this approach would make for example the meeting of the RED targets less 'ILUC prone' would depend, however, on the penetration of the identified LIIB practices and whether they can be made mandatory in one form or the other. Another concern is that while the use of (unused) land with no or low ecosystem services for biofuels will mitigate ILUC, this land might well be needed in the future to produce food and feed for a growing global population. Therefore the cultivation of biofuel crops on unused land should be seen as a medium-term solution until other alternatives to decarbonise the transport sector are more readily available.

A final word on the comparison of high- and ´project-level approaches: Dehue *et al* (2011) argue that a shortcoming of the high-level or global options as they call them is that they are outside the sphere of influence of the biofuel industry. While this is correct, there is no reason why one should not argue for policy intervention to adopt these high-level approaches, some of which (universal criteria, land use planning) would be beneficial long-term solutions to reduce pressure on land worthy of protection not only from biofuel feedstocks but also from wider land using activities. This can be argued all the more given that it was to a large degree policy intervention that created the biofuel industry and hence led to its knock-on effects on land use etc in the first place.

6.3 Practicality of land use planning

This section spells outs some of the necessary conditions for land use planning/zoning to be an effective approach to mitigate ILUC, apart from the fact that it would have to be adopted on a near global scale to mitigate unwanted land use change, as argued above.

- A rather fundamental question is how far we can regulate how land is being used in an effective way in democratic countries, especially where private land ownership is the norm. Complete control is rarely achieved; how much of a compliance gap can be tolerated? One area where rural land use planning occurs in countries at various levels of development is through the designation of protected areas, which could be understood as zoning on a higher, above-project level. Designations, rules and levels of control vary greatly. The zoning itself is only part of the issue; protection requires an appropriate consent procedure, monitoring, enforcement, etc.

- It is clear, and experiences in existing mapping initiatives bear witness to this fact, that zoning itself is far from trivial and any attempt is likely to face areas of dispute for example because of mal-defined land categories. The question then arises which organisations are competent and appropriate to undertake the necessary analysis and data gathering to inform land use zoning. In deciding whether it should be the government (central, local, agencies etc) or could be done by private parties (eg biofuel developers) the scale of zoning emerges as a key issue. The data gathering for regionally contained initiatives might well be done (and funded by) private developers in collaboration with local civil society interest groups. Zoning of larger (including country-wide territories) would seem more feasible and politically acceptable if conducted at a central government level. The question that arises is why governments would engage in such planning activities above and beyond those that suit their purpose for other reasons since it can be a relatively demanding exercise. Yet this would be required in many cases to allow biofuel production that meets EU requirements. One reason could be that they hope to attain a 'first-mover advantage' particularly where zoning would include the designation of areas that are suitable for development in the sense that development would not compromise critical environmental and/or social needs. Such designated 'safe' areas might attract investors, especially those that care about the social and environmental implications of their investment decisions.

- Monitoring and surveillance are key for meaningful land use zoning to take effect and enforcement of any zoning decisions is likely to be an enormous challenge in some countries at least. The likelihood of succeeding on this front depends on governance structures and the resources applied but at the same time it cannot be taken for granted that functioning governance structures will lead to effective enforcement. A European example in the bioenergy context is the set of regulations to maintain permanent pasture in Germany that are nevertheless being converted to cropland for green maize cultivation to feed biogas production. Important determinants are likely to be ownership structures: In centralised systems, where land use decisions are to a large extent state or church controlled for example it is likely that zoning could be implemented more easily. At the same time, such centralised systems could be susceptible to corrupt behaviour with individuals in a position to overthrow legitimate decisions. The ability to enforce land use decisions is key; without it, land use planning would have to be dismissed as an effective policy option to mitigate unwanted land use change

The barriers to be overcome for land use zoning to be an effective tool to address ILUC seem rather insurmountable in the short run, especially with regard to enforcement challenges and above all the need for widespread adoption. Still, the approach has its merits, especially when seen as a tool to move towards long-term first best solutions for mitigating ILUC, ie the prevention of any unwanted LUC globally and for all sectors.

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ANNEX 1: PROTECTED AREA DEFINITIONS

For rapid, clear and concise reference, UNEP-WCMC has developed an online guide to important areas for biodiversity conservation, the vast majority of items below are succinctly summarised and can be conveniently accessed through: http://www.biodiversitya-z.org/.

- Article 2, Use of Terms, CBD Convention[29]

"Protected area" means a geographically defined area which is designated or regulated and managed to achieve specific conservation objectives.

"Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

- Communication, Education and Public Awareness (CEPA) Toolkit Glossary (IUCN and CBD, 2008)

"Protected Areas" An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means. A protected area can be under either public or private ownership.

- IUCN (2011)

"Protected Areas" A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.

Example Protected Areas

- **Ramsar** (The Convention on Wetlands of International Importance) - covered by wetland provisions
- **Biosphere sites** (UNESCO Man and Biosphere Programme)

[29] http://www.cbd.int/convention/text/

- **World Heritage Sites** (UNESCO Convention on the Protection of the World Cultural and Natural Heritage (1972)
- **Natura 2000**

ANNEX 2: AREAS CONSIDERED TO BE OF HIGH CONSERVATION VALUE BY GOVERNMENTAL AND NON-GOVERNMENTAL ORGANISATIONS

A 2.1 International

- **Key Biodiversity Areas (KBA)**

The KBA approach was developed in 2004 and is supported by the IUCN and BirdLife International, Plantlife International, Conservation International, Critical Ecosystem Partnership Fund, and over 100 national/regional civil society and governmental conservation agencies. The identification and delineation of KBAs is an ongoing process, Appendix I and II of (Langhammer *et al*, 2007) contains a list of KBA's identified to date by country and online data sources for identifying and delineating KBAs.

The identification of KBA's (inside or outside of protected areas) is applied using species that require site-level conservation based on two criteria, irreplaceability and vulnerability. There is no maximum or minimum size, and KBA serve as an 'umbrella' framework, encompassing sites such of global significance; Important Bird Areas (IBAs), Important Plant Areas (IPAs), Important Sites for Freshwater Biodiversity, Ecologically and Biologically Significant Areas (EBSAs) in the High Seas, and Alliance for Zero Extinction (AZE) sites.

A KBA can be identified under the vulnerability and the irreplaceability criteria simultaneously (Figure 4).

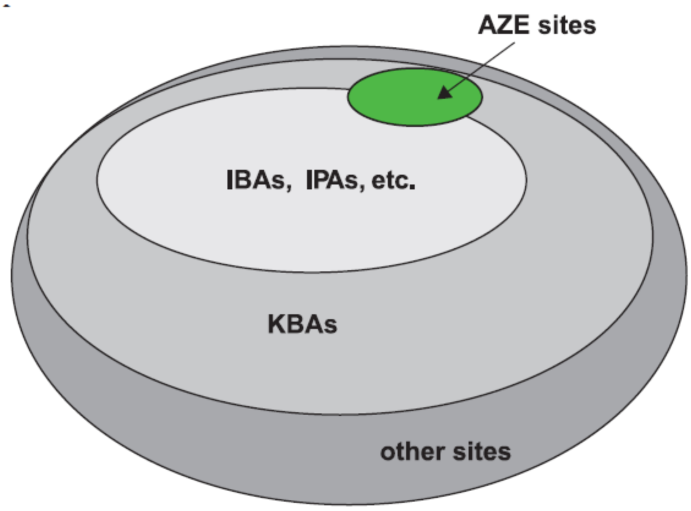
Figure 4: Summary of KBA criteria and thresholds from (Langhammer *et al*, 2007)

Criterion	Sub-criteria	Provisional thresholds for triggering KBA status
Vulnerability Regular occurrence of a globally threatened species (according to the IUCN Red List) at the site	N/A	Critically Endangered (CR) and Endangered (EN) species – presence of a single individual Vulnerable species (VU) – 30 individuals or 10 pairs
Irreplaceability Site holds X% of a species' global population at any stage of the species' lifecycle	a) Restricted-range species	Species with a global range less than 50,000 km^2 5% of global population at site
	b) Species with large but clumped distributions	5% of global population at site
	c) Globally significant congregations	1% of global population seasonally at the site
	d) Globally significant source populations	Site is responsible for maintaining 1% of global population
	e) Bioregionally restricted assemblages	To be defined

Species threatened at sub-global levels are included but those assessed using old Red Lists are not included. For further insights of the KBA approach to freshwater and marine realms see (Darwall and ViIë, 2005) and (Edgar and Brooks, 2011).

Figure 5 is a useful diagram, depicting the relationship between IBAs, KBAs and AZE sites.

Figure 5: Relationship between IBAs, KBAs and AZE sites (Langhammer *et al*, 2007)



- **Endemic Bird Areas (Birdlife International)**

  Defined as *An area which encompasses the overlapping breeding ranges of restricted-range bird species, such that the complete ranges of two or more restricted-range species are entirely included within the boundary (STATTERSFIELD et al*, 1998). A restricted-range species is defined as one having a historical breeding range of no more than 50,000 km. At the local level, the identification of representative sites is carried out through BirdLife's Important Bird Area IBA Programme (see below). By conserving representative significant sites within the EBAs, efforts can be directed at entire groups of species and the ecosystems upon which they depend, rather than at single species level.

- **Important Bird Areas (Birdlife International)**

  IBAs are small enough in area to be conserved in their entirety and frequently already part of a protected-area system. They do one (or more) of three things: (i) Hold significant numbers of one or more globally threatened species, (ii) Are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species (iii) Have exceptionally large numbers of migratory or congregatory species.

- **Important Plant Areas (Plantlife International)**

  Important Plant Areas (IPAs) are areas of landscape that have been identified by the UK based organisation Plantlife as being of the highest botanical importance given the occurrence of internationally important wild plant populations. In 2007, Plantlife announced the establishment of 150 such areas across the UK. The work of Plantlife International stretches beyond the UK through collaborations on IPA projects in over 66 countries and through promoting work on European and Global identification criteria for IPAs.

- **Crises Ecoregions**

  This has been presented in the form of peer reviewed journal article by researcher's affiliated with TNC and WWF (USA) (Hoekstra *et al*, 2005). The aim was to identify the world's terrestrial biomes and, at a finer spatial scale, ecoregions in which biodiversity and ecological function are at greatest risk because of extensive habitat conversion and limited habitat protection.

- **Biodiversity hotspots** (Conservation International)

  These are currently used by the Critical Ecosystem Partnership Fund (CEPF) to direct their investment strategy. The CEPF unites Conservation International, the L'Agence Française de Développement, The Global Environment Facility, The Government of Japan The John D. and Catherine T. MacArthur Foundation and The World Bank.

- **Global Ecoregions** 200 (WWF)

- **High-Biodiversity Wilderness Areas** (HBWA) (CI)

- **Intact Forest Landscapes** (IFL) (World Resources Institute (WRI) and Greenpeace in partnership with Biodiversity Conservation Centre, International Socio-Ecological Union and Transparent World)

- **Last of the Wild** (Wildlife Conservation Society (WCS) and the Center for International Earth Science Information Network (CIESIN), Columbia University

- **Centres of Plant Diversity (CPD) (IUCN WWF)**

- **Alliance for Zero Extinction (AZE) Sites** (a joint initiative of 68 biodiversity conservation organizations around the world). They are no-go areas according to the Roundtable on Sustainable Biofuels RSB.

- **IUCN RED List of Ecosystems**

  The IUCN Commission on Ecosystem Management global initiative is currently developing the application of the IUCN Red List of Threatened Species methods to ecosystems. The first large-scale test has already been applied to Venezuelan terrestrial ecosystems. A series of workshops, one in Washington, which will advance the scientific basis of the categories; others in countries such as China, Chile, France and Senegal, for the implementation of the tool in different types of ecosystems, are being planned for 2011[30].

A 2.2 Regional

- **Emerald Network** (The Bern Convention on the Conservation of European Wildlife and Natural Habitats)
- **Specially Protected Areas of Mediterranean Importance (SPAMI)** (Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention).
- **The Association of Southeast Asian Nations ASEAN Heritage Parks** (IUCN, UNEP-WCMC)

[30] http://www.iucn.org/knowledge/news/?uNewsID=7482

A 2.3 National lists

Other lists of areas (not already covered by other sections of Article 17) including (but not limited to) containing nationally threatened species/ecosystems regionally threatened species/ecosystems

For example in Brazil:

- **Brazil's Ministry of the Environment official Red book of Endangered Fauna** (Ministério do Meio Ambiente - MMA and Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA), 2008)

- **Brazil's Ministry of the Environment official lists of Endangered Flora** (Ministério do Meio Ambiente - MMA, 2008)

  Species on both these lists have both national and internationally legally binding obligations, including environmental crime legislation and overlapping with MEA's CITES IUCN Red list etc. They also play a key role in influencing national biodiversity priority areas and protected areas or 'conservation units (Unidades de Conservação).

- **Brazil's Ministry of the Environment priority areas** (Ministério do Meio Ambiente - MMA, 2007)

ANNEX 3: INITIATIVES TO SUPPORT THE IMPLEMENTATION OF LAND USE SUSTAINABILTY SCHEMES

In the following we introduce a selection of approaches that have been developed to help operationalize sustainability schemes (eg for timber production), but which are not specifically focused on biofuel production. We also cover (pre-)planning tools for use in general project developments including industrial developments.

A 3.1 High Conservation Value approach

Some land planning initiatives and voluntary sustainability schemes for biofuels (and other commodities) use identified High Conservation Value (HCV) areas as a primarily source of information, and therefore their criteria, as the basis for mapping areas that have very high biodiversity and/or conservation value. The approach is therefore described in more detailed as part of this annex as one important, ie widely cited, approach to identifying priority areas for conservation.

The HCV approach to protecting important biodiversity and social values was originally developed by the Forest Stewardship Council (FCS) in the context of forest certification (High Conservation Value Forests or HCVF) in the late 1990s. The approach has since been further developed by a network of biodiversity conservation organisations and other stakeholders and is being applied to other kinds of ecosystems and habitats[31]. The approach focuses on protecting and enhancing the following six types of HCV that cover the range of conservation priorities shared by a wide range of stakeholder groups[32]:

1. Areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia). For example, the presence of several globally threatened bird species within a Kenyan montane forest.
2. Globally, regionally or nationally significant large landscape-level areas where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance. For example, a large tract of Mesoamerican flooded grasslands and gallery forests with healthy populations of Hyacinth Macaw, Jaguar, Maned Wolf, and Giant Otter, as well as most smaller species.
3. Areas that are in or contain rare, threatened or endangered ecosystems. For example, patches of a regionally rare type of freshwater swamp in an Australian coastal district.

[31] http://www.hcvnetwork.org/

[32] http://www.hcvnetwork.org/about-hcvf/The%20high-conservation-values-folder

4. Areas that provide basic ecosystem services in critical situations (e.g. watershed protection, erosion control). For example, forest on steep slopes with avalanche risk above a town in the European Alps.
5. Areas fundamental to meeting basic needs of local communities (e.g. subsistence, health). For example, key hunting or foraging areas for communities living at subsistence level in a Cambodian lowland forest mosaic.
6. Areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities). For example, sacred burial grounds within a forest management area in Canada.

The approach identifies HCV areas, which are defined as natural habitats where these values are considered to be of outstanding significance or critical importance. Thus an HCV area is simply the area where these values are found, or, more precisely, the area that needs to be appropriately managed in order to maintain or enhance the identified values. For example, the FSC uses them to define forest areas of outstanding and critical importance – and then (under Principle 9 of the FSC's Principles and Criteria of Forest Stewardship) requires forest managers to identify any HCVs that occur within their individual forest management units, to manage them in order to maintain or enhance the values identified, and to monitor the success of this management.

One of the benefits of the approach is that it is based on broadly settled principles that can be applied globally and to all ecosystem types and their various values (eg see the report of the 2008 Joint International Workshop on Bioenergy and Biodiversity[33]). The approach also covers ecosystem services and social values that are not normally dealt with in other approaches to identifying areas of high conservation value. This is especially valuable because such values are outside the realm of geographic datasets or imagery obtained from satellites.

However, the HCV approach does have some drawbacks and constraints. Firstly in practice HCV areas are normally of extremely high biodiversity conservation importance (rather than "very high" as the terms implies). The detailed HCV criteria for forests[34] indicate that such areas have "extraordinary concentrations of species, including threatened or endangered species, endemics, unusual assemblages of ecological or taxonomic groups and extraordinary seasonal concentrations". The exact meaning of the terms threatened and endangered species are not clarified in the criteria, but seem to refer to globally threatened species according to the IUCN Red List criteria. The criteria also indicate that only in exceptional circumstances would an HCV area be identified for a single species. Thus it is important to note that **these criteria are clearly focussed on extremely high levels of conservation importance**. Therefore HCV areas should not be used as the sole basis (criterion for identifying high-risk / no-go areas for biofuels). High-risks maps should therefore also include other areas that have been identified as being of particular biodiversity conservation value, including Key Biodiversity Areas (KBAs), or areas identified

[33] http://www.bioenergywiki.net/Joint_International_Workshop_Mapping
[34] http://www.hcvnetwork.org/about-hcvf/The%20high-conservation-values-folder/hcv1

through the Systematic Conservation Planning approach (see for instance (Margules and Pressey, 2000) and (Sarkar and Illoldi-Rangel, 2010)).

A further constraint with respect to the RED sustainability criteria is that grassland HCV areas have not been identified and the approach does not currently contain specific provisions for or guidance on assessing grasslands, however, natural grasslands may – at least to some extent – be covered by the first four HCV types. Some grasslands might qualify as HCV areas on the basis of the type 1 HCV values, however, the very high biodiversity importance standards used (as described above) are only likely to be rarely met by grasslands. Furthermore, such sites would almost certainly qualify as protected areas, in which case HCV recognition would confer no further protection for grasslands from biofuel production as other RED sustainability criteria already explicitly rule out protected areas.

Some natural grasslands would qualify as HCV areas according the presence of type 2 values, but the requirement for large areas that support viable populations of the natural species would exclude grasslands that have become fragmented and/or lost key animal communities (eg native large herbivores), even though they may be of high biodiversity value for other reasons (eg in terms of their near natural plant communities). Some of these ecologically degraded grasslands might be sufficiently rare and threatened to qualify as HCV areas according to type 3 values. It is, however, evident that adaptation of the existing criteria would not necessarily capture a high proportion of remaining natural grasslands of high biodiversity value.

Some grasslands might also qualify as HCV areas in terms of their ecosystem service benefits (eg HCV type 4 values relating to the protection of soils or water supplies), but these values are not related to the RED criteria for highly biodiverse grasslands. Consequently, HCV areas that are only identified for these should not necessarily be excluded from biofuel production on biodiversity grounds.

The HCV Network has indicated that it is concerned with grasslands being converted for either biofuels or tree plantations, and have tried to address some of the issues of identification. This is, however, work in progress. To date the HCV network has not attempted to formulate an 'approved' set of criteria or indicators for HCV grasslands. The main aim of extending the HCV concept to cover grasslands has not, to date, been to protect grasslands generically but to identify grassland areas of importance in forest areas and to aid forestry management.

A typology of grassland types has been discussed within the HCV network, but it is not clear to what extent this is being taken forward and if grassland HCV are being identified.

A 3.2 Local Ecological Footprinting Tool (LEFT)

In summary, the LEFT tool is introduced as 'a systematic tool for determining the ecological value of landscapes outside of protected areas; [...it] uses existing globally available web-based databases and models to provide an ecological score based on five key ecological features (biodiversity, fragmentation, threat, connectivity and resilience) for every 300m parcel within a given region. The end product is a map indicating ecological value across the landscape. … It provides a pre-planning tool, for use before undertaking a more costly field-based environmental impact assessment, and quickly highlights areas of high ecological value' (http://www.biodiversity.ox.ac.uk/left, by University of Oxford and Kathy Willis). The method has been demonstrated by means of case studies in three study regions, Canada, Algeria and the Russian Federation. It should be noted that this is not an initiative targeted at biofuel production or agricultural production in general but is rather presented here as an example of producing maps with a strong reliance on available data and GIS tools. The tool has been developed by Kathy Willis and colleagues at the University of Oxford and in collaboration with partners including ARC, Proforest, the HCV Network, Staatsbosbeheer, Statoil and UNEP-WCMC.

LEFT is a pre-planning tool (for use before a more elaborate environmental impact assessment) indicating the ecological value of the landscape for any location globally going beyond protected areas. It is mainly targeted at 'practitioners involved in planning the location of any industrial and/or business facility outside of protected areas'.

The following assumptions underly the development of the methodology and formulate its aim: '(1) … it should be based on multiple valuation factors, (2) make use of free spatial data available for almost any location worldwide, and (3) be at a scale that is relevant to the extent of most development concessions, ideally <0.5 km' (Willis *et al*, 2012). The ecological scoring underlying the maps is based on five key ecological criteria: biodiversity, vulnerability, fragmentation, connectivity and resilience. This is to cover both 'ecological properties and of the landscape' and the 'key features important for supporting ecosystem functions' (Willis *et al*, 2012, p5).

Outputs are developed based on existing globally available web-based databases and models. These were compiled to allow for the calculation of the five ecological value criteria listed above (see Willis *et al*, 2012, p5-6 for detailed explanations of how the different criteria are calculated). Values for the five criteria are then summed into an 'overall dimensionless indicator of ecological value' according to a specifically developed algorithm (Willis *et al*, 2012, p5). The so derived ecological indicators form the basis for the output maps. The resolution of the output maps is determined by the availability of vegetation cover data. These are taken from GLOBCOVER and come in pixels of 300m. Hence output maps of 300m parcel resolution are produced; according to Willis et al (2012) this represents a 'spatial scale relevant to most landscape scale planning decisions'.

A 3.3 International Biodiversity Assessment Tool for business (IBAT for business)

In summary, 'IBAT for business is an innovative tool designed to facilitate access to accurate and up-to-date biodiversity information to support critical business decisions'. It is essentially 'a central database for globally recognized biodiversity information including Key Biodiversity Areas and Legally Protected Areas. Through an interactive mapping tool, decision-makers are able to easily access and use this up-to-date information to identify biodiversity risks and opportunities within a project boundary. Exportable maps make it easy for users to quickly share biodiversity assessment results' (https://www.ibatforbusiness.org). As is the case with LEFT, it should be noted that this project is not targeted biofuel feedstock or more generally agricultural production.

The development of IBAT was facilitated by collaboration between BirdLife International, Conservation International, International Union for Conservation of Nature and UNEP-WCMC.

The specific functions of IBAT are described as follows:

'IBAT helps businesses incorporate biodiversity considerations into key project planning and management decisions, including:

- Screening potential investments
- Siting an operation in a given region
- Developing action plans to manage for biodiversity impacts
- Assessing risks associated with potential sourcing regions
- Reporting on corporate biodiversity performance'.

It is further clarified that IBAT mapping only captures 'the tip of the iceberg for biodiversity'. Therefore the screening that IBAT represents 'should be supplemented by further literature review, spatial analyses, local expert advice and stakeholder consultation during each stage of the project life cycle. … The power of IBAT is in highlighting critical issues and information gaps that should be quickly followed by further on-the-ground surveys and consultation in order to understand the current status of the site and the magnitude of the project's potential impacts on these species, communities and ecological processes' (https://www.ibatforbusiness.org/ibat_and_your_business).

In terms of the outputs produced, Willis *et al* (2012) explain that IBAT produces 'mapped output at a spatial scale (~20km) that is often too coarse for most landscape planning decisions.

The IBAT mapping is based on several databases of protected areas, including (see https://www.ibatforbusiness.org/data_behind_ibat for more information):

- World Database of Protected Areas (WDPA);
- Key Biodiversity Areas (KBAs);
- Alliance for Zero Extinction (AZE);
- IUCN Red List of Threatened Species;

- Broad-scale conservation priorities: Biodiversity Hotspots, Endemic Bird Areas, High Biodiversity Wilderness Areas.

A 3.4 Eyes on the forest

EoF (http://www.eyesontheforest.or.id/) is a coalition of three local environmental organizations in Riau, Sumatra, Indonesia: WWF Indonesia's Tesso Nilo Programme, Jikalahari ("Forest Rescue Network Riau") and Walhi Riau (Friends of the Earth Indonesia). EoF does not identify specific areas in need of protection but rather focuses on all the natural forest areas in Riau. The project, launched in December 2004, aims to investigate the state of Riau's forests and the players who influence it. The awareness raising component of the project relies on a range of data to produce web based maps of forest area change identifying reasons for change. Eyes on the Forest aims to become a clearinghouse for information on forest conservation in Riau, Sumatra and to serve as a tool for local, national, and international NGOs, companies, governments and any other stakeholders who are willing to take action to conserve forests and protect the rights of the local people who rely on them.

The project also has a second component which utilizes satellite remote sensing information (SPOT and Landsat ETM) to identify recent changes to forest areas which are then followed up with ground based surveys to verify change. This change detection approach is used to verify the nature of forest change and highlight illegal activities where they are identified.

The data used to generate the web based maps of forest area change can be found here: http://maps.eyesontheforest.or.id/Home/sources.html. They include the following:

Satellite RS data – SPOT and Landsat ETM

Forest Cover

- Forest Cover 1982: World Conservation Monitoring Centre (1996) Tropical Moist Forests and Protected Areas: The Digital Files. Version 1. Cambridge: World Conservation Monitoring Centre, Centre for International Forestry Research, and Overseas Development Administration of the United Kingdom..
- Forest Cover 1988, 1996: Indonesian Ministry of Forestry and World Bank, Digital data set (2000).
- Forest Cover 2000, 2002: WWF (2003) Landsat ETM Images analysis.
- Forest Cover 2004, 2005: WWF (2005) Landsat ETM Images analysis.

Protected Areas

- Riau Forestry Service (Dinas Kehutanan) (2002).
- Ministry of Forestry (2004).

Elephant Range

- Elephant 1985 Data: Raleigh A. Blouch and Kuppin Simbolon (May 1985) Elephants in Northern Sumatra, IUCN/WWF Report No. 9 Project 3033 Field Report. IUCN/WWF Conservation for Development Programme, Bogor.
- Elephant 1996-1999 Data: Nukman, BKSDA (1999).
- Elephant 2003 Data: Nurchalis Fadhli et al., (2004) Elephants in Tesso Nilo and The Conflict. WWF AREAS Riau Project, Pekanbaru, Riau, Sumatra Indonesia.

Human Elephant Conflict Data

- Nukman, BKSDA Survey 1996 – 1999.
- WWF Survey 2003 – 2006.

Information on Pulpwood Plantations (Industrial Timber Plantations)

- Forest Conversion License Holding Company: Riau Forestry Service (2005) & Ministry of Forestry (2005).
- License Number, License Issued by, Type of License: Riau Forestry Service (2005).
- Size of Area (Ha): Riau Forestry Service (2005).
- Associated Pulp Mill: Riau Forestry Service (2005), APRIL, public documents by APP.
- MoF Review Status: Public information.

Oil Palm Concessions (approx)

- Oil palm 2002 concession data: Riau Plantation Service (2002).
- Oil palm 2004 concession data: Riau Plantation Service (2004).

Forest Fires

- MODIS Web Fire Mapper (August 2004 - July 2007).
- Forest Fire Prevention Management Project 2 (Ministry of Forestry & JICA) (January 2001-July 2004).

Other data

- Road: WWF Survey 2000 – 2005, Bakosurtanal (1986) Topography Map 1 : 250.000,
- 1 : 50.000.
- River: Bakosurtanal (1986) Topography Map 1 : 250.000, 1: 50.000.
- Administration: Riau BAPEDA (Riau Province Government) (2000).
- Cities, mills: WWF (2002 – 2004).

ANNEX 4: MAPPING APPROACHES AND OTHER INITIATIVES RELEVANT TO THE CULTIVATION OF BIOFUEL CROPS

Contrary to the Annex 3, this annex reviews mapping initiatives and other relevant initiatives that aim to identify suitable areas for the cultivation of crops that may be used for biofuels. While the heading of the annex refers to biofuel crops, it should be noted that although crops that may be used for the production of biofuels, but that might be used for other (food, feed, other industrial) purposes in practice. The majority of the approaches below have been developed in the context of the biofuel sustainability debate, such as RCA, RTRS or the SuLu project. At the same time, the outcomes of these projects may become used beyond the biofuel sector. The Potico project does not focus on biofuel development but on sustainable growing areas for palm oil plantations, no matter what the end use of the palm oil will be.

A 4.1 Responsible Cultivation Areas (RCA)

Summary:

The RCA methodology has been elaborated by Ecofys in collaboration with WWF and Conservation International. The methodology focuses on the site selection phase, intended for use by companies, (industry) roundtables and land-use planners to identify existing areas and/or production models that can be used for environmentally and socially responsible energy crop production without causing detrimental direct and indirect effects. Case studies have been conducted in Brazil, Mozambique and Indonesia. The RCA approach has been developed further into a methodology for low indirect impact biofuels (LIIB, 2012). This is described in more detail in Chapter 6 of this report.

Function:

Site selection of suitable bioenergy production areas via a four-step process (Dehue *et al*, 2010; Budiman *et al*, 2010):

1) Desk-based site pre-selection on a large scale based on coarse but readily available information;
2) Desk-based assessment to further refine the pre-selection;
3) Field work to verify the results of the first two steps and to fill all remaining knowledge gaps;
4) Evaluation whether an area is classified as a RCA based on information gathered in previous steps.

Principles and criteria:

The principles and criteria used to identify RCAs are listed in Budiman *et al* (2010) (p4). However, these appear to relate primarily to criteria[35] and the overarching principles behind the approach are not explicitly stated.

Data:

- For desk-based pre-selection: 'Preliminary map in GIS-format containing the most promising areas within the total research area … based on the overlay of several layers of GIS maps. Each of these maps contains information on one of the six aspects considered in the RCA identification process: High Conservation Values, carbon stocks, formal and customary land rights, risk of unwanted displacement effects, and agricultural suitability';
- Combination of constraint-driven (eg based on IBAT information/mapping) and opportunity-driven approach (eg identified areas of Imperata grassland); see Dehue (2010, p37) for potential data sources;
- Additional (desk-based) information sources for refining pre-selection;
- Additional data / information gathered as part of field work to feed into final evaluation.

Further information:

Dehue *et al* (2010) provide details on the methodology. An example for the methodology in practice is given by the report 'Identification of Responsible Cultivation Areas in West Kalimantan Indonesia – Phase I Preliminary Assessment' by Budiman *et al* (2010). Also by the same authors the Phase II 'Desk-based Analysis' (http://www.hcvnetwork.org/resources/assessments/Phase%20II%20-%20Identification%20of%20Responsible%20Cultivation%20Areas%20In%20West%20Kalimantan%20Indonesia.pdf) and Phase III 'Field verification' (http://www.hcvnetwork.org/resources/assessments/Phase%20III%20-%20Identification%20of%20Responsible%20Cultivation%20Areas%20In%20West%20Kalimantan%20Indonesia.pdf) reports.

A 4.2 SuLu project

The SuLu project is ongoing and the information below may be subject to changes. All final reports and maps as well as interims product will be published on the project website www.globallandusechange.org

Summary:

The SuLu (Sustainable Land Use)[36] project is led by WWF Germany and the work is undertaken in close cooperation with WWF partners in the study regions Indonesia and

[35] Such as: Maintaining or increasing High Conservation Values; maintaining carbon stocks; formal and customary land rights are respected; unwanted displacement effects are avoided.

[36] The official name of the project is 'Balancing land use management, sustainable biomass production and conservation, climate change and conservation'. The project is financially supported by the German

Colombia, with scientific oversight and technical expertise on geographical information systems provided by the US based WWF Conservation Science Program (CSP). The project will lend practical support to the EU Renewable Energy Directive (EU RED) by supporting the development of spatial planning concepts for the Llanos grasslands in Colombia and the eco-regions of Kalimantan and Sumatra with a focus on the RIMBA region in Indonesia in partnership with local stakeholders, like governments, communities and conservation groups to avoid greenhouse gas emissions and minimize pressure on land with high biodiversity caused by biomass production.

Acting through the sustainability criteria of the Renewable Energy Directive, SuLu is identifying the most important areas for the conservation of biodiversity and lands with high carbon stock value. SuLu is working with stakeholders on the development of methods to identify no go (in the sense of breaching the RED sustainability criteria) and high-, medium- and low-risk areas[37] (which are not covered by EU RED) for sustainable biomass production. The project uses geographic techniques to define and communicate RED requirements and to integrate advanced landscape analysis into spatial planning with local stakeholders. It aims to develop together with stakeholders a methodology to define and identify highly biodiverse grassland (SuLu website, see below).

The RED sustainability criteria represent the overall policy context of the project. The work in the project regions takes into account additionally the national legislative framework. In Colombia, for instance, a national suitability map for palm oil developed with WWF involvement already exists that will be used as reference. This map includes environmental criteria that go partly beyond the RED's criteria and include such inputs as 'conservation priority areas, threatened and restricted species distributions, ecosystem integrity and singularity, water regulation and ecosystem services' (Suarez, 2011).

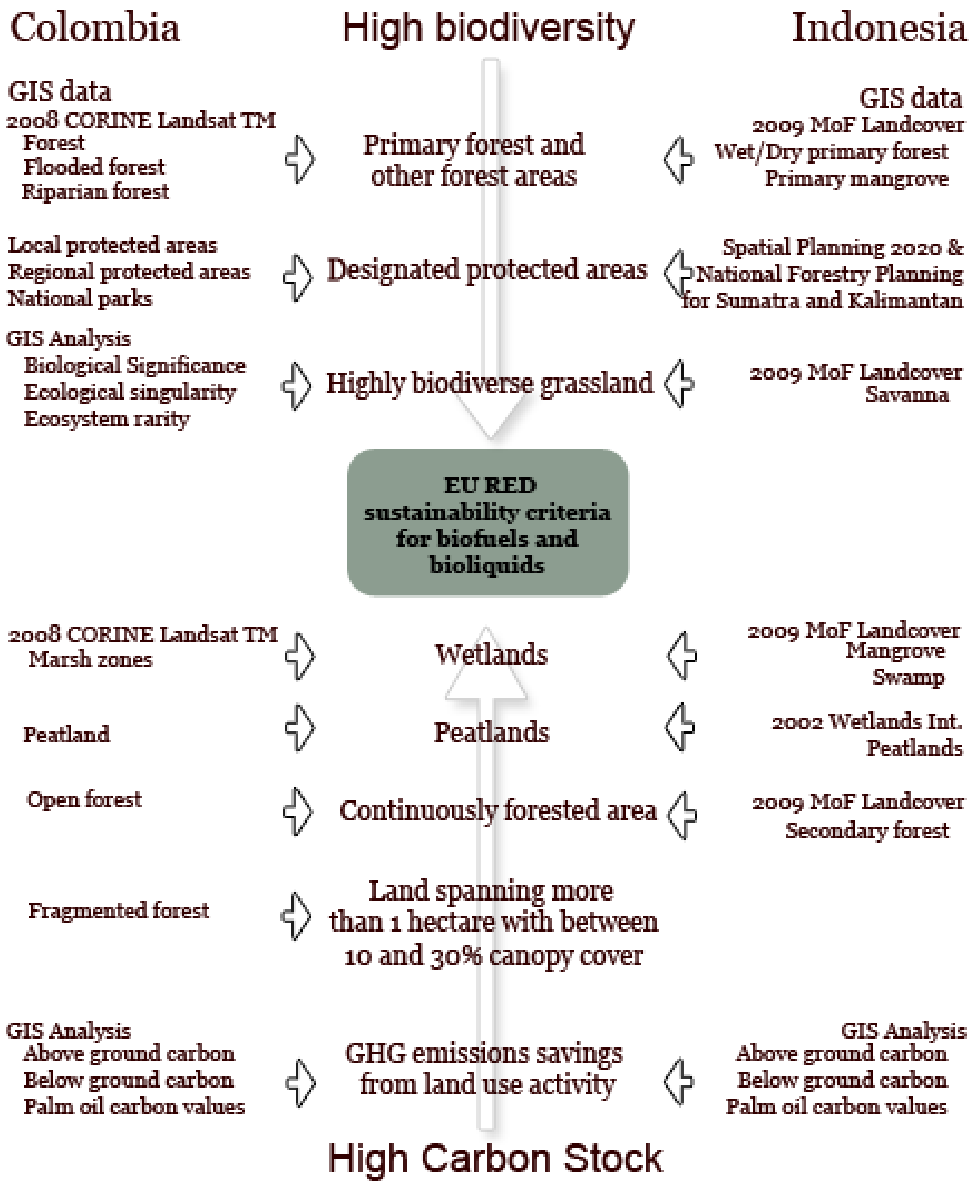
Function:

Developing methods to identify `EU RED no-go´ areas as well as high and low-risk areas for sustainable biomass production beyond bioenergy uses by developing a tool to identify the most important areas for the conservation of biodiversity and high carbon stocks; providing practical tools for certification, spatial planning and communication.

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) within its International Climate Initiative.

[37] The SuLu project is ongoing, the final definitions and naming of categories beyond EU RED is in progress with national stakeholders

Figure 6: Overview of data used to map EU RED criteria



Data:

The approach taken including data needs differ according to the project regions. Figure 6 presents the data used in Colombia and Indonesia to map EU RED criteria. Further data information on Colombia including a summary of available data sources can be found in Suarez (2011, pp23-24). A data report by the Indonesian team provides an extensive list of data sources including geographical scales (see Sulistyawan and Hadian, 2011, pp23-27). Three separate geographic dataset types were used as geographic surrogates of EU RED language: land cover, wetland and peatland data.

SarVision uses state-of-the-art satellite techniques to produce an above-ground biomass map for Kalimantan showing the status in the year 2008. The map has a high spatial resolution of 50 metres and covers the entire territory of Kalimantan. It is produced using a combination of satellite Radar and Lidar[38] technologies. In order to verify the biomass maps based on imagery technology, extensive observations on land cover in west, central and east Kalimantan were undertaken. This included field biomass measurements in 54 0.1ha plots[39].

According to Sept 2011 presentation by WWF CSP (see below), a two-tiered approach to modelling at different levels of resolution has emerged:

1. Regional land use spatial planning model
    - Suitable for large scale mapping (1:100,000)
    - Can be used as a guideline for identification of EU RED no-go, as well as low and high biodiversity risk areas
    - Unsuitable for local scale analysis
    - Will incorporate regional data (biodiversity, carbon, land cover, etc.)

2. Local land use spatial planning model
    - Site-level conservation assessments will be encouraged
    - Fine scale analysis will give further guidance to clarify EU RED compliance
    - Will produce small scale maps (~1:25,000)[40]

In the case of ***Colombia***, the two-tiered approach translates into:

- Medium-level analysis of the entire Colombian Llanos regions
- Targeted stakeholder outreach into pilot region

In the case of ***Indonesia***, the two-tiered approach translates into:

- Medium-level analysis of Kalimantan (Borneo) and Sumatra:
- Higher-resolution analysis of central Sumatra (provinces of Jambi, Riau and West Sumatra) that includes stakeholder outreach.

Principles and criteria:

The approaches to identify areas outside of the 'EU RED no-go' category are different in the two countries. While Colombia considers a range of biological criteria, the Indonesian mapping is more focused on the occurrence of key species. This choice for the different approaches was primarily influenced by the different ecosystems found in each country. The Colombian Llanos are primarily a grassland ecosystem which qualifies as 'no-go' when an area contains high biodiversity or is a non-natural grassland that is species rich. Since the criteria for high biodiverse grasslands were not defined by the EU commission yet, the Colombian team is working on national suggestions. The Indonesian islands of Sumatra and

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[38] Light Detection And Ranging

[39] The map is available online (see link below).

[40] Or 1:10,000, depending on the pilot test window.

Kalimantan are historically heavily forested regions. The Indonesian landscape therefore is more responsive to the EU RED sustainability criteria that focus on the presence of forest, woodland and peatland.

Areas in breach of the RED criteria are classified as 'EU RED no-go'. Apart from this areas are assessed by the Colombian team based on their:

- biological significance;
- ecological integrity;
- ecosystem singularity;

The case study region in Colombia is a grassland ecosystem. WWF-Colombia's approach was developed to obtain a spatial output that identifies highly biodiverse grasslands as an EU RED 'no-go' area as well as grasslands with conservation value since highly biodiverse grasslands are not defined in the EU RED yet but are under conversion pressure for different kinds of uses. A range of indicators are used to assess areas against these criteria. The resulting scores are normalised to as to allow a ranking of areas taking into account all criteria and enabling the categorisation into low, moderate, high risk and no-go.

Further information:

- Project website: http://www.globallandusechange.org/
- The results of the project including maps produced will be communicated via a web platform with crowd-sourcing capabilities developed by the Moabi team: http://drc.moabi.org/
- Presentation 'Sustainable Land Use Risk Mapping' from Berlin Workshop Sept 2011 by WWF CSP: http://www.globallandusechange.org/tl_files/glcfiles/wwf/Berlin%20workshop%202011/Sulu_Risk%20mapping_WWF_CSP%20for%20workshop.pdf
- SarVision 2008 above-ground biomass map for Kalimantan: http://www.globallandusechange.org/tl_files/glcfiles/wwf/SuLu%20Reports/Sarvision%20Kalimantan%20AGB%20map%202008.jpg
- Suarez, C F (2011) *Geographic Data Gap Analysis Balancing spatial planning, sustainable biomass production, climate change and conservation – a practical multi-stakeholder approach for climate mitigation*. Available at: http://www.globallandusechange.org/tl_files/glcfiles/wwf/SuLu%20Reports/SuLu_Geographic%20Data%20Gap%20Analysis_Colombia.pdf.
- Sulistyawan, B S and Hadian, O (2011) *Assessing Spatial Data of Sumatra and Kalimantan Based on the European Union Renewable Energy Directive Regulation*. Available at: http://www.globallandusechange.org/tl_files/glcfiles/wwf/SuLu%20Reports/SuLu_Spatial%20data%20Report_Indonesia.pdf

A 4.3 Agri-ecological zoning for sugarcane expansion in Brazil: ZAE Cana

Summary:

The objective of agri-ecological zoning for sugarcane expansion (ZAE Cana) is to identify areas where sugar cane production can expand with minimal environmental or social impacts whilst respecting the need or desire to continue biofuel feedstock production in Brazil). The mapping approach is aimed to direct subsidies and financing only to expansion of operations within areas that meet certain criteria. This process is underpinned by national law on sugarcane production[41].

Function:

Ex-ante suitability assessment

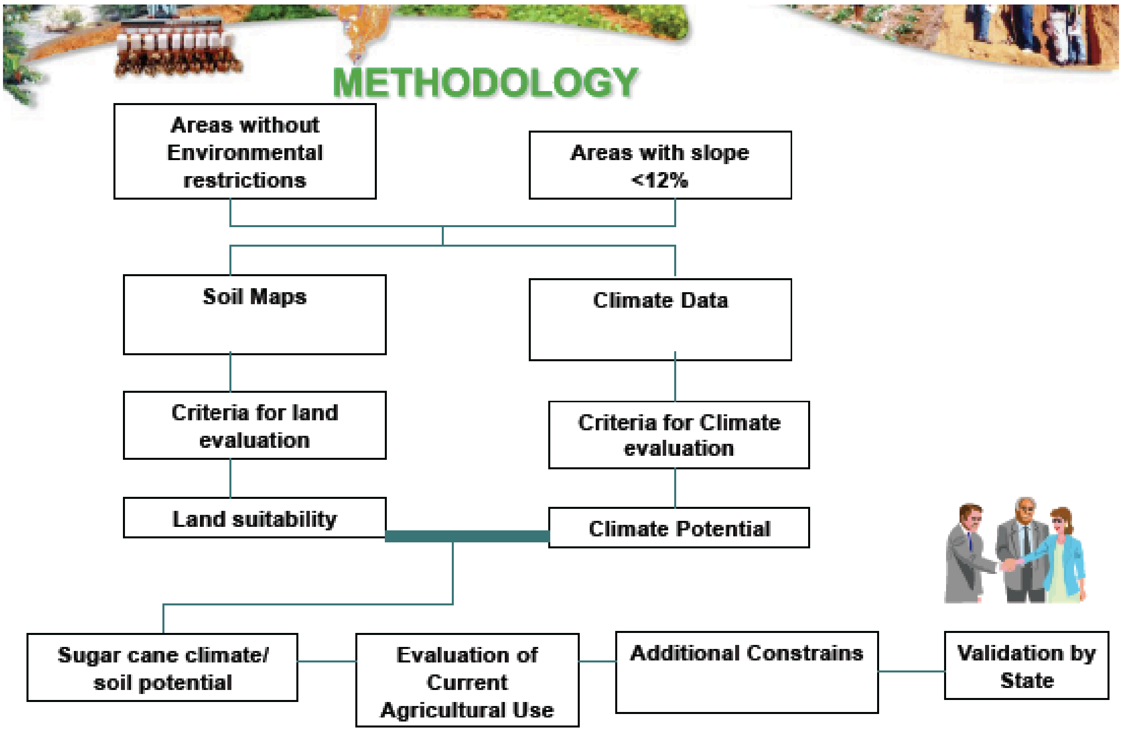
Principles for assessing potential impacts:

Rules to guide sugarcane production

1. Exclusion of areas with native vegetation
    a. As soon as the national law is approved it will be prohibited to remove native vegetation for sugarcane expansion.
2. Exclusion of areas for cultivation in the Amazon and Pantanal biomes and in the Upper Paraguay River Basin
3. Identification of areas with agricultural potential without need of full irrigation
    a. Selection of sugarcane varieties in conjunction with weather and soil conditions to select areas in which sugarcane production uses the lowest volume of water possible.
4. Identification of areas with slope below 12 per cent
    a. Areas with 12 per cent slope allow mechanical harvesting. ie avoiding burning.
5. Respect for food security
    a. The national bill will empower the MoA to guide sugarcane production so as not to interfere with food security
6. Prioritization of degraded areas or pasture
    a. focus sugarcane on pasture or degraded land

[41] A Bill is proposed to prevent any sugarcane expansion in certain areas, limit subsidies to suitable areas and empower the Ministry of Agriculture to guide sugarcane production.

Figure 7: ZAE Cana methodological process



The zoning doesn't apply to existing sugarcane plantations, only to new operations. It also only applies to sugarcane cultivation for sugar and bioethanol production (ie not for brown sugar, *cachaça*, or animal feed). The zoning only applies to sugarcane expansion, and most of the area deemed suitable for sugarcane expansion is already in use for other types of agriculture which still leaves the opportunity for displacement and resultant ILUC (for example Lapola *et al*, 2010). The guidelines claim to avoid areas that are already in use for food production, in order to decrease direct competition, and avoid threats to food security, but it's not clear how exactly they ensure this.

Data:

Unclear from current information

Links:

http://www.unica.com.br/downloads/sugarcane-agroecological-zoning.pdf

http://www.bioetanol.org.br/hotsite/arquivo/editor/file/20%20Workshop%20Sustentabilidade%20/2nd%20WKS%20Sustainability%20-%20Calso%20Manzato-Embrapa%20-%20Ethanol%20Agroecological%20Zoning.pdf

A 4.4 RTRS broad scale maps and HCV guidance for soy expansion: Multi-stakeholder process (Roundtable on Responsible Soy, RTRS)

Note that the information below may be subject to changes as the project is ongoing and most of the information has been obtained from personal communication with the project developers.

Summary:

'The proposed project supports the implementation of responsible soy production in Brazil, according to RTRS standard, by making operational maps for responsible soy expansion via multi-stakeholder process. … The overall goal of this project is to reduce the negative impact of soy expansion on high biodiversity ecosystems and areas of high conservation value (environmental or social) in Brazil via the development of a generic methodology and national processes to create broad scale suitability maps and site-scale HCV assessment guidance for responsible soy expansion.' (Project website, see link below).

The focus of the project is on protecting biodiversity. However, by assigning the whole Amazon biome Category I status (see below) hence excluding it from agricultural expansion for soy production under RTRS, carbon stock considerations are to some extent taken into account. The technical mapping work is coordinated by a steering group that includes representatives from industry, soy producers, civil society as well as researchers and the state planning authority. An advisory group composed of researchers and producers revises the material produced by the steering group, and a National Stakeholder meeting is planned to be held for public debate and further revision.

Function:

Suitability maps and site-scale HCV assessment that will be adapted to the Brazilian context (based on an indicator tool to be developed as part of the project) to identify areas for expansion. This is under the assumption that soy cultivation area will expand due to market forces. The aim of the project is to steer expansion into the right direction by preventing expansion into 'critical biodiversity' areas and steer producers towards using formerly or degraded pasture areas.

The output of the project will include a public database of maps, guidance and reports, accessible for producers and certifiers and for any other interested party (ie round tables like Bonsucro, RSB, and others).

Principles and criteria:

HCV based approach; local applicability and definition to be defined as part of the ongoing project. The project distinguishes four area categories:

- Category I Areas: areas which are critical for biodiversity (hotspots), where stakeholders agree there should not be any conversion of native vegetation to responsible soy production;

- Category II Areas: areas with high importance for biodiversity where expansion of soy is only carried out after an HCVA assessment which identifies areas for conservation and areas where expansion can occur;
- Category III Areas: areas where existing legislation is adequate to control responsible expansion (usually areas with importance for agriculture and lower conservation importance);
- Category IV Areas: areas which are already used for agriculture and where there is no remaining native vegetation except legal reserves and so no further expansion is occurring.

The purpose of the project will be to produce maps identifying and distinguishing these area categories.

Data:

Ongoing process, no detailed information available yet.

Further information:

- RTRS' High Conservation Value Areas Project (HCVA) website: http://www.responsiblesoy.org/index.php?option=com_content&view=article&id=387&Itemid=190&lang=en
- Main contact: Daniel Meyer, Project manager and RTRS representative in Brazil, Daniel.meyer@responsiblesoy.org

A 4.5 BioCarbon tracker

Summary

BioCarbon Tracker aims to provide a clear picture of where carbon is stored, which reserves of biocarbon are most at risk from agricultural expansion, and where there are opportunities to improve biocarbon reserves through better land management.

The project is a collaboration between Greenergy, Ecometrica, University of Edinburgh and the UK National Centre for Earth Observation. BioCarbon Tracker uses processed satellite data in conjunction with IPCC carbon estimations to map global above and blow ground carbon stocks. A risk analysis is carried out identifying if an area is under a form of protection, its suitability for agricultural production and the distance from local habitats. These three factors are combined to estimate the potential risk of any given area to agricultural expansion. When combined with the estimates of carbon stocks a biocarbon risk index is produced.

Function:

Facilitation / awareness raising / ex-post change detection / ex-ante risk assessment

Principles for assessing potential impacts:

No principles are proposed for assessing potential impacts. Methodology focuses on identifying areas at risk but leaves decision makers to use this information in good conscience.

Data:

Satellite RS data – GLCF 300m resolution (Envisat's Medium Resolution Imaging Spectrometer (MERIS) instrument) (ESA, 2010)

FAO ecofloristic regions (FAO, 2000)

Continental zones (Ruesch and Gibbs, 2008)

Frontier forests (Bryant et al. 1997)

IPCC carbon stock values (IPCC, 2006)

Estimated travel time (Nelson, 2010)

Protected areas (IUCN and UNEP, 2009)

Suitability index (van Veithuizen et al, 2007))

Links:

http://biocarbontracker.com
http://biocarbontracker.com/uploads/Methods-above-ground-carbon_mapping.pdf

A 4.6 Potico Project (World Resources Institute (WRI)

Summary

POTICO seeks to prevent deforestation in Indonesia and enable sustainable supply of palm oil by diverting planned oil palm plantations away from natural forests and onto degraded lands. Project POTICO is led by the World Resources Institute (WRI) with partners including Indonesian field partner in Sekala, the Puter Foundation, Indonesian Centre for Environmental Law, and Rainforest Alliance. WRI also engages several oil palm companies, palm oil buyers, the Roundtable on Sustainable Palm Oil (RSPO), the PRP, the Indonesian REDD+ Task Force, and the Norwegian government in executing the project and conducting outreach.

The project methodology identifies suitability criteria based on a set of environmental, economic, social and legal considerations that align with established sustainability standards and Indonesian regulations and policies. These criteria are then used to determine areas that could be subject to cultivation for biofuel feedstocks that comply with the land related sustainability criteria of the RED, the proposed national REDD+ and protect other areas of high environmental importance.

There are four stages to the overall approach proposed by WRI, these are:

- Stage I: Desktop analysis
- Stage II: Field assessment
- Stage III: Initial selection
- Stage IV: Due diligence

The following summary focuses primarily on 'Stage 1: Desktop analysis' which includes the approach to mapping potentially suitable areas for cultivation.

Function:

Ex-ante suitability assessment.

The mapping component of the project is designed as a first step tool for companies in a site selection process for a certified sustainable plantation and can inform government officials and nongovernmental organizations (NGOs) in assessing land use policy options to support the expansion of sustainable palm oil production on degraded land. ***However, since it is designed primarily to rapidly identify the highest priority areas for further investigation, it should not be used to predetermine where oil palm cultivation expansion should occur.***

Principles for assessing potential impacts:

Principles to identify suitable areas for oil palm production are broken down into four main categories, environmental, economic, legal and social. Each category is further broken down with key questions surrounding suitability.

Environmental

- Carbon and biodiversity - Is land 'degraded' from a forest carbon standpoint and can negative impacts on biodiversity 'high conservation values (HCV 1-3) be avoided?

- Soil and water protection - Can negative impacts on environmental services and vulnerable areas be avoided (HVC 4)?

Economic

- Crop productivity - Are climate, topography and soil conditions conducive to the cultivation of oil palm?
- Financial viability - Are size and accessibility to infrastructure sufficient to address company-specific financial concerns?

Legal

- Zoning - Does land status allow for conservation to agricultural uses?
- Rights - Can existing land use claims from both companies and communities be addressed?

Social

- Land use - Is development unlikely to negatively impact social 'high conservation values' including livelihood activities (HCV 5-6)?
- Local interests - Do relevant populations express initial interest in oil palm cultivation and willingness to participate in further discussions? Are political considerations positive?

Stage I of the assessment process uses map based information to identify potentially suitable areas for cultivation worthy of further investigation based on the above principles. Three categories of potential are identified, high potential, potential and not suitable. Two steps are taken, first a suitability mapping exercise is carried out based on available information relative to the principles outlined above. However, due to the limitations in the accuracy and availability of provincial-level data necessitate verification in the field. Furthermore, some considerations, particularly those relating to social issues, cannot be assessed using a desktop analysis. Therefore the second step involves the identification of sites for field survey follow up under Stage II. The criteria relative to each step are shown in Table 4 and the information included in the mapping process can be found in Gringold *et al* (2012).

Table 4: Considerations, indicators and stages used in the POTICO suitability assessment

Consideration		Indicator	Stage I. Desktop analysis: Step 1. Suitability mapping	Stage I. Desktop analysis: Step 2. Field survey site selection	Stage II. Field assessments
Environmental	Carbon and biodiversity	Land cover	X		X
		Peat	X		X
		Conservation areas with buffer zones	X		
	Soil and water protection	Erosion risk	X		X
		Groundwater recharge potential	X		
		Water resource buffers	X		
Economic	Crop productivity	Topography (elevation; slope)	X		X
		Climate (rainfall)	X		
		Soil (depth; type; drainage; acidity; color)	X		X
	Financial viability	Size		X	X
		Accessibility		X	X
Legal	Zoning	Land classification		X	X
	Rights	Concessions		X	X
		Active plantations			X
		Community claims/rights	*Outside the scope of this method. Must be addressed through additional activities before the suitability of a site is confirmed*		
Social	Land use	Land use dependence	X*		X
		Manmade drainage			X
		Land history			X
	Local interests	Community perception of oil palm			X
		Community interest in planting oil palm			X
		Political interests			X

**Land cover is used as a proxy for land use during desktop analysis. Land use is assessed directly during field assessments.*

Data:

As identified in
Table 4 only the indicators relative to carbon and biodiversity, soil and water and crop productivity are mapped, the data sources for these indicators can be found in Table 5. The remaining indicators are the subject of field survey site selection and field assessments.

Table 5: Data sources used for suitability mapping in the POTICO project

LAYER	INDICATOR	DATA SOURCE
Carbon and biodiversity	Land cover	Ministry of Forestry (2009, 1:250,000 scale)[a]
	Peat	Wetlands International (2004, 1:250,000 scale)[b]
	Conservation areas with buffer zones	Calculated by authors using 1,000 m buffer around conservation areas from Ministry of Forestry (Unknown, 1:250,000 scale)[a]
Soil and water protection	Erosion risk	Calculated based on modified version of the Universal Soil Loss Equation (USLE) as suggested by HCV Toolkit for Indonesia (2008), using topography, climate, and soil data described below.
	Groundwater recharge potential	Insufficient data – not included in application.
	Water resource buffers	Calculated by authors, using 100 m buffer around water resources data available in Interactive Atlas of Indonesia's Forests (2009, 1:250,000 scale)[b]
Crop productivity	Topography (elevation; slope)	Shuttle Radar Topography Mission (2008, 90 m resolution)[c]
	Climate (rainfall)	WorldClim Global Climate data (1989–2009, 1000 m resolution)[d]
	Soil (depth; type; drainage; acidity)	RePPProT (1990, scale 1:250,000); Soil type classification from FAO Soil Map guidelines.[e]

a. Ministry of Forestry data available as of February 2012 at <http://appgis.dephut.go.id/appgis/ >: *Penutupan Lahan 2009* (Land cover 2009) and *Kawasan Hutan* (Forest Estate), no year provided.
b. Data available in S. Minnemeyer, L. Boisrobert, F. Stolle, Y.I. Ketut Deddy Muliastra, M. Hansen, B. Arunarwati, G. Prawijiwuri, J. Purwanto, and R. Awaliyan. 2009. Interactive Atlas of Indonesia's Forests CD-ROM. Washington, DC: World Resources Institute.
c. Available at < http://www2.jpl.nasa.gov/srtm/cbanddataproducts.html >.
d. Available at <http://www.worldclim.org/ >.
e. The FAO Digital Soil Map of the World and associated information can be downloaded at: <http://www.fao.org/geonetwork/srv/en/metadata.show?id=14116>.

Source: Gringold et al (2012)

Links:

- http://www.projectpotico.org
- Gingold, Beth, A. Rosenbarger, Y. I. K. D. Muliastra, F. Stolle, I. M. Sudana, M. D. M. Manessa, A. Murdimanto, S. B. Tiangga, C. C. Madusari, and P. Douard. 2012. "How to identify degraded land for sustainable palm oil in Indonesia." Working Paper. World Resources Institute and Sekala, Washington D.C. Available online at: http://pdf.wri.org/working_papers/how_to_identify_degraded_land_for_sustainable_palm_oil_in_indonesia.pdf

ANNEX 5: SUMMARY OF REVIEW OF TOOLS AND METHODS BY BÖTTGER (2011)

Another sub-project of the SuLu project has focused on tools and approaches to identify biodiverse areas and especially highly biodiverse grasslands (Böttger, 2011). Some of the approaches reviewed by Böttger are included in Annex 2 of this report already; those are HCV, KBA and RCA/LIIB. Additional approaches reviewed by Böttger are:

- High Nature Value Assessment (HNV);
- Rapid Assessment (RA);
- Environmental and Social Impact Assessment (ESIA);
- Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST).

Böttger briefly introduces these different approaches (Böttger, 2011, p5):

- **HNV**: The HNV approach takes into account the relation between agricultural land and 'natural values'. 'HNV farming systems are low intensity, low input systems, frequently with high structural diversity' (REF Cooper et al, 2007, 'HNV Indicators for Evaluation') http://ec.europa.eu/agriculture/analysis/external/evaluation/ex_sum_en.pdf). Initially, this approach was used for agricultural land only. Meanwhile, it was expanded to forestry as well. HNV is a European concept. Further information: http://www.high-nature-value-farming.eu/.
- **RA**: The Rapid Assessment Program (RAP), developed in 1990 by Conservation International. Objectives: ecological information shall be provided fast, to support and implement the protection of nature in decision making processes. The evaluation is executed by a team of experts who compile the relevant information about biodiversity within four to six weeks. Further information: https://learning.conservation.org/biosurvey/RAP/Pages/default.aspx.
- **ESIA**: Environmental and Social Impact Assessments assess prior to a project its future consequences for the environment and the social structure of the defined area. The approach was developed in the 1970s. Apart from the effects on environment and society through human activities, it shall also work out measures to prevent negative and to support positive effects.
- **InVEST**: InVEST is a modelling tool, to forecast the origin, distribution and economic value of ecosystem services. Different influences and consequences of possible decisions are visualised, as well as dependencies between the environment, the economy and the social sphere. Fields of application like carbon sequestration, water quality, quantity and (temporal) distribution of water, pollination of grain, production of grain and wood and other cultural advantages are modelled. Further information: http://www.naturalcapitalproject.org/InVEST.html.

Böttger assesses the different approaches based on criteria to determine RED compliance such as consideration of species; consideration of ecosystems and social criteria; uniform standards (criteria, indicators and application); validity of results; as well as criteria to determine applicability and cost-benefit ratios, such as financial effort / costs, time needed and scalability to larger areas/ regions (Böttger, 2011, p19).

The following is a brief summary of the assessment results (Böttger, 2011, p19):

- **ESIA**: rather unfavourable cost-benefit-ratio, of limited use for large-scale areas;
- **HNV**: EU focus, no particular consideration of ecosystems, only for agricultural land already in use;
- **InVEST**: complex approach with a distinctive assignment, no explicit consideration of endangered species, no integrated standards.

HCV, RA, KBA and RCA are considered to be capable of being used on the larger scale for distinguishing between areas of high and low biodiversity value. Nevertheless, weak points are noted that need to be improved. The following Figures summarise his assessment.

Figure 8: Evaluation of selected methodologies (Böttger, 2011, p20)

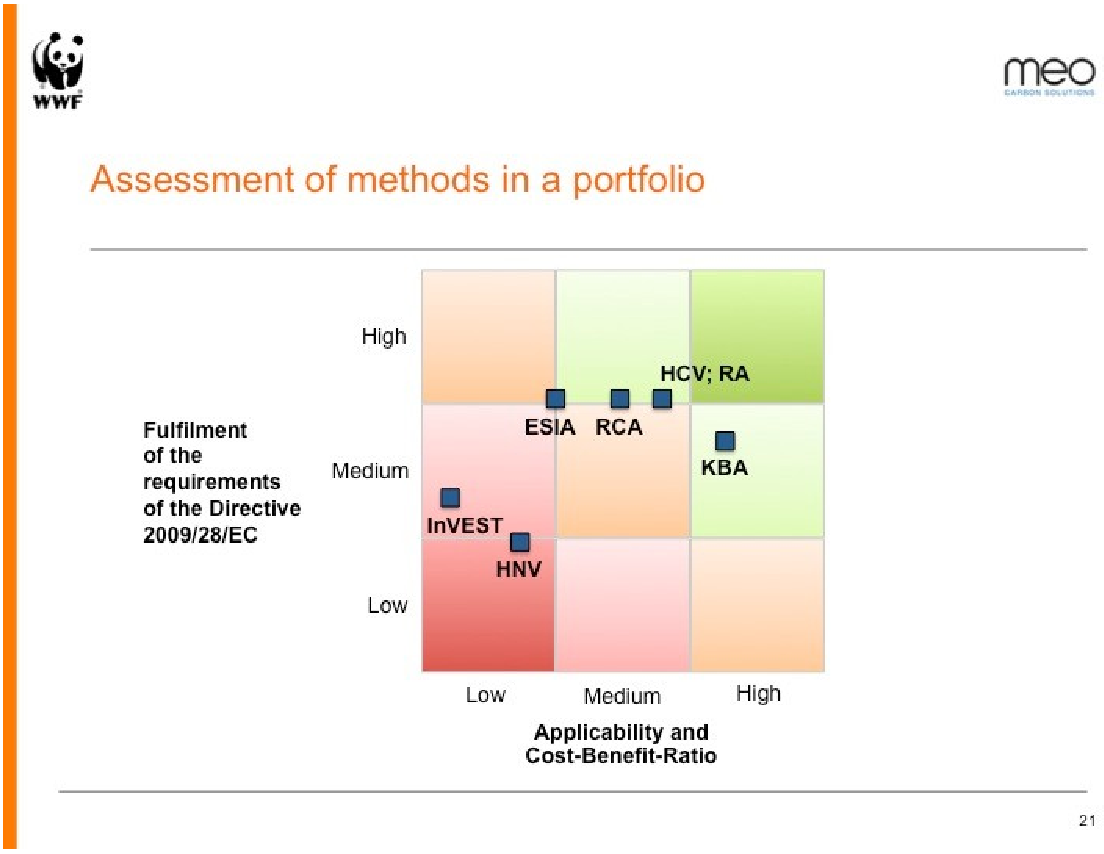
Assessment of selected methods for the assessment of biodiversity

Criteria	HCV	KBA	HNV	RA	RCA	ESIA	InVEST
Fulfilment of the requirements of the Directive 2009/28/EC							
Consideration of species	5	5	3	5	5	5	2
Consideration of eco systems and social criteria	3	1	1	2	3	5	5
Uniform standards (criteria, indicators and application)	3	4	3	4	3	1	1
Validity of results	4	3	2	4	4	4	3
Total I Average	**15 3,75**	**13 3,25**	**9 2,25**	**15 3,75**	**15 3,75**	**15 3,5**	**11 2,75**
Applicability and Cost-Benefit-Ratio							
Financial effort/cost	3	5	2	4	2	3	1
Needed time	4	4	3	4	3	2	1
Scalability for larger areas/regions	3	3	1	2	4	2	2
Total I Average	**10 3,3**	**12 4,0**	**6 2,0**	**10 3,3**	**9 3,0**	**7 2,3**	**4 1,3**

Fulfilment: 5 = high; 1 = low

20

Figure 9: Assessment of methods in a portfolio according to compliance of RED-requirements and applicability and cost-benefit-ratio (Böttger, 2011, p21)



ANNEX 6: PROPOSED PROCEDURE FOR OPERATIONALIZING THE RED SUSTAINABILITY CRITERIA FOR HIGHLY BIODIVERSE GRASSLANDS

From Bowyer *et al* (2010), adapted from Bowyer (2010).

Principles and assumptions

In order to develop an assessment system to take account of highly biodiverse grasslands, in line with Directive 2009/28/EC, it is necessary to clearly set out assumptions and core principles. The following are a list of principles upon which the authors consider ANY system for delivering the grassland criteria in Directive 2009/28/EC should build.

General

- ***Embodying the Precautionary Principle*** - The Lisbon Treaty, Article 191 specifies that EU policy on the environment "shall be based on the precautionary principle", that is there is an institutional preference in support of a precautionary approach to environmental change. It is fundamental that the principle of precaution be applied to the development of grasslands, given the irreversibility of damage to grasslands from ploughing and reseeding for crop based production with potential significant impacts upon biodiversity and carbon stocks. In the event of uncertainty over the biodiverse status of a grassland, development should not be pursued.
- ***Burden of proof*** - The onus must be placed upon the operator to prove that a grassland is not highly biodiverse. Based on the Directive text the objective of Article 17.3 is to protect lands of high biodiversity value, hence in situations where status is uncertain the emphasis must be to prove that land is not biodiverse. The inappropriate application of the burden of proof could undermine the Directive's objectives for the protection of highly biodiverse lands and lead to a system that requires administrative effort but delivers limited or no environmental benefit.

Protecting biodiverse grasslands

- **Recognising the Directive's aim** - That the overall ambition of Directive 2009/29 /EC Art 17 is to protect land of high biodiversity value of which highly biodiverse grasslands are one subset
- ***Taking account of other rules on biodiversity protection*** - Decisions on the appropriate location for biofuels feedstock production should take into account international, national and local biodiversity conservation obligations and policies, including national biodiversity strategies and action plans (NBSAPs) developed in accordance with the Convention on Biological Diversity.
- **Protecting all grasslands of biodiversity value** - Within Directive 2009/28/EC there is no hierarchy distinguishing levels of protection between natural and non-natural grasslands. All grasslands that are deemed highly biodiverse should be protected irrespective of whether it is possible to easily differentiate between the two.

Natural grassland [42]

- **Human activity and defining natural grasslands -** That non natural grasslands are assumed to be those created by extensive human interventions that have dramatically changed the natural system, for example via deforestation. Despite not being created by human intervention many natural grasslands may be maintained by human activity, for example domestic livestock populations or mowing which have replaced the maintenance role previously provided by wild herbivore populations. In the majority of cases natural grasslands will be 'used' by humans in some way.
- **Looking beyond vegetation composition** - That natural grasslands are valued based on the maintenance of their natural assemblages, but this should take account of more than simply vegetation composition.
- **Taking account of natural variability** - That natural composition expected within a grassland will vary considerably depending upon the biological system and bio-geographic region.

Assessing non natural grassland [43]

- **Variable biodiversity value** – That there is a hierarchy of appropriateness in terms of conversion of non natural grasslands for feedstock production, not all non natural grasslands are of equal biodiversity value.
- **Assessing species richness** – The consideration of species richness in non-natural grasslands should not be restricted to plants. Thus species-rich non-natural grasslands should include grasslands that are species-rich with respect to any taxa group (for example plants, invertebrates, reptiles, birds and mammals).

  Furthermore, consideration of species richness should not be solely based on small-scale assessments, for example species per m^2. Larger scale species diversity patterns are equally important. Thus grasslands should also be protected if they hold rare or otherwise threatened species or species assemblages, the loss of which would reduce larger scale biodiversity.
- **Accounting for degradation** – That degradation of grassland should be shown to be beyond a certain threshold, given that this is part of a continuum. In particular care should be taken if establishing that degradation has been caused by overgrazing, as this can often be rapidly reversed once grazing pressure is reduced. When determining the quality of grassland long-term indicators of sward condition and, in particular, species composition and richness should be used rather than indicators of immediate condition/degradation.

The decision process

- **Agreeing the dataset** – The best available data (for example on the location of natural grasslands or other areas of high biodiversity value) should be used for

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[42] Natural grasslands are defined in Directive 2009/28/EC as '*namely grassland that would remain grassland in the absence of human intervention and which maintains the natural species composition and ecological characteristics and processes*'

[43] Non natural grassland is defined in Directive 2009/28/EC as '*namely grassland that would cease to be grassland in the absence of human intervention and which is species-rich and not degraded, unless evidence is provided that the harvesting of the raw material is necessary to preserve its grassland status*'.

assessments and these should be agreed by national / regional competent environmental authorities.

- **Balancing comparability and regional flexibility** – Assessment and accreditation systems should be based on agreed generic principles and standards, but allow some flexibility to take into account local circumstances (for example the ecological characteristics, condition and functions of grassland types present, data availability and capacity for assessments).
- **Expert assessments** – Expert assessments should be carried out by appropriately trained, accredited and independent assessors, and overseen by an independent third-party certification body.
- **Non expert assessments** – Non expert assessments can be used in some instances, but to ensure effective application this needs to be supported by a transparent and publically reported validation system overseen by an independent third-party.

A Potential Assessment Model

Set out below and in the following Figure is a proposed model for a 3 level assessment process. Detailed proofs and decision steps under each level are presented in Annex I. ***It should be noted that all biofuels would not have to undergo all 3 levels of assessment***. Biofuels would only need to progress through the process to the point at which the evidence base is sufficient to determine whether land is deemed either:

- highly biodiverse grassland, therefore unsuitable for biofuel development to meet the EU demand generated by Directive 2009/28/EC; or
- not of high biodiversity value and therefore biofuel production would comply with EU requirements for the protection of grassland.

There are a number of other requirements that biofuels entering the EU market place must comply with, based on Article 17. ***This three level assessment process for grassland is, therefore, envisaged as part of the wider approach to the assessment of biofuels to approve their environmental credentials*** in line with Directive 2009/28/EC. It is intended that the three levels will deliver a process that is robust but also not excessively onerous.

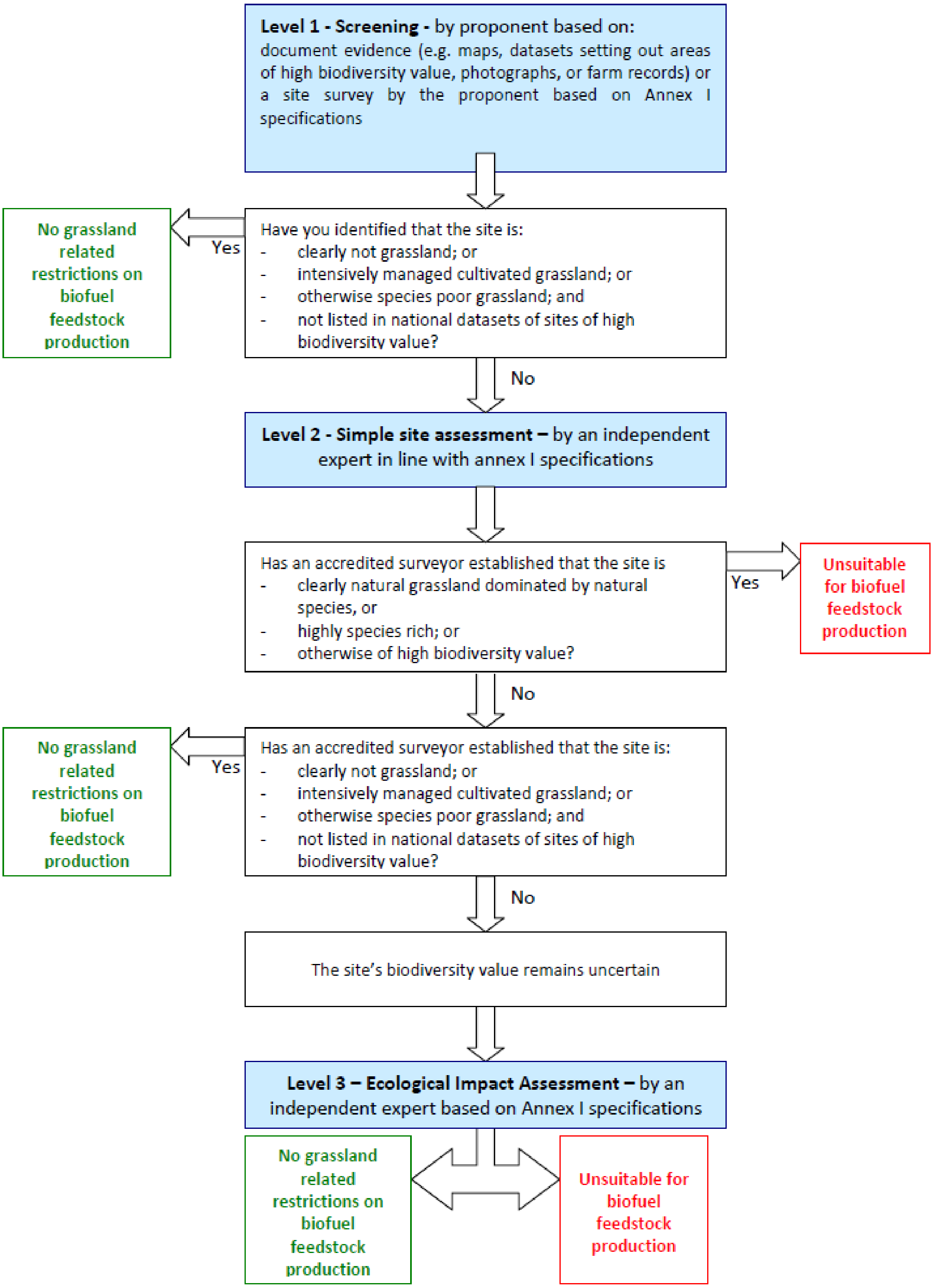
Level 1 aims to exclude from further assessment grasslands that are obviously intensively managed, not species–rich or of any other known biodiversity importance. This assessment would be undertaken by the proponent/farmer/developer, with a transparent verification system established by a national competent authority (for example involving checks of a proportion of assessments). It would entail a simple screening of the land based on clear guidelines (see Annex I).

If it is not possible to identify, and provide sufficient proof, that a grassland is suitable for conversion to biofuel feedstock production from a Level 1 assessment, then the analysis of the land progresses to ***Level 2*** (assuming the proponent still wishes to proceed with the development of land for biofuel feedstocks). Under Level 2 a simple on-site assessment is required to establish if the site is potentially suitable for biofuel production. This would be carried out by an independent accredited assessor, although as set out in Annex I this should not involve onerous cost to the proponent with the assessment constrained in terms of duration and level of effort. At this stage a site might be identified as suitable or unsuitable for biofuel feedstock production in line with Directive 2009/28/EC, or the status of the land remains uncertain.

If it has still not been possible to determine the status of the land's suitability under Directive 2009/28/EC, and the proponent still wishes to take this forward, they should progress to ***Level 3***. This encompasses a detailed assessment based on good practice standards for Ecological Impact Assessment completed by an independent specialist. This assessment should provide a judgement and include proofs to demonstrate that the grassland is not of biodiversity value. ***If after all three assessment levels are complete significant doubt remains over its biodiversity value, biofuel feedstock production on that land should not be considered to qualify under Directive 2009/28/EC Article 17***.

Proof, based on level 1, 2 or 3, demonstrating that land does not contain grassland of high biodiversity value would need to be provided to demonstrate compliance before biofuel feedstocks could be processed. A record of this proof and the assessment process undertaken would need to be presented to the processer, forming the first stage of a traceable chain of custody allowing EU Member States to identify the compliance of biofuels entering the EU with Directive 2009/28/EC. This process would need to be supported by institutions to support the assessment processes, review of records and undertake verification. This is necessary to ensure clarity, consistency of approach and avoid frustrating developers.

Figure 10: A three level decision structure - a basis for assessment



Detailed Level Based assessment

Note: all threshold numbers quoted below in square brackets are indicative only. It is recommended that actual threshold values should be set at a national level by the statutory environmental authority, through a transparent science-based process in consultation with stakeholders.

The following methodology, presented below, is an illustration of the approach that could be taken to assessing the suitability of all grassland areas (natural and non natural) for the production of biofuels. This sets out in detail the assessment questions and criteria that should be applied to assessment Levels 1, 2 and 3 set out in the Figure above.

Level 1: screening (by proponent)

The site can be considered by the proponent to have no restrictions on biofuel production with respect to grassland sustainability criteria (and therefore no requirement for further survey) if:

- The site is not grassland and can be proven not to have been grassland in 2008 (for example according to approved datasets[44] such as official land records, land use maps, aerial photographs or satellite images); OR

- The site is grassland, but can be proven (for example according to approved datasets) to have been cultivated (that is ploughed or harrowed) and/or reseeded within the last [10] years and prior to 2008[45]; OR

- At least two of the following apply to the site on the basis of a self assessment[46] (according to standardised guidance):
  - Cover of rye grasses and clover (and other agricultural grasses / cultivars according to national circumstances) more than [30%]; or
  - The sward is species poor, with [4] or less species/m^2; or
  - There is less than [10%] cover of herbs, sedges and shrubs (excluding clover and undesirable species according to local circumstances).

AND

[44] I.e. the best available data as identified and approved by the competent environmental authority.
[45] Unless it is an extensively managed (with no or minimal use of fertilisers) and equivalent to High Nature Value farmland as defined in the EU.
[46] An agreed percentage of self assessment would be verified by an appropriate competent authority, with prosecutions made where appropriate.

- The accreditation authority has determined that the site is NOT listed on the standard source of data on highly biodiverse grasslands as approved by the statutory environmental authority[47],[48].

ALL OTHER PROPOSALS MUST CARRY OUT A LEVEL 2 GRASSLAND SURVEY.

Level 2: grassland survey

A grassland survey is carried out by an independent accredited assessor to establish key ecological and management information, including the grassland/biotopes present (for example with respect to, plant species richness, dominant species present in the sward, overall cover of agricultural cultivars (for example rye-grasses and clover), cover of herbs and sedges, management systems in place and ecological condition (with respect to key attributes). The assessor would also check the location of the site against maps and other data sources indicating the location of natural grasslands, protected areas and other areas identified as being of high biodiversity value (for example Important Bird Areas).

The site should NOT be used for biofuel production with respect to grassland sustainability criteria if:

- It holds more than [0.5 ha] of grassland within a mapped area of natural grassland (according the standard source of data on natural grasslands as approved by the statutory environmental authority) and is dominated by species of the natural grassland type (according to approved standard lists), and is therefore natural grassland as described in the Directive; OR

- The site is listed on the standard source of data on highly biodiverse grasslands as approved by the statutory environmental authority, or is otherwise found by survey to:
    - hold significant populations of globally, regionally or nationally threatened species, or endemic species, or important populations of associated fauna;
    - consist of a scarce or otherwise threatened biotope of high biodiversity value (e.g. as listed in Annex 1 of the EU Habitats Directive, a NBSAP or qualifies as a High Nature Value farmland area in the EU); OR

- At least two of the following apply to non natural grasslands on the site on the basis of the expert assessment:

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47 This should include protected areas (which are excluded from biofuel production according to Article 17.c.2 of the Directive) and sites that are not formally protected, but are nevertheless of high biodiversity value, such as Important Plant Areas, Important Bird Areas and, within the EU, areas of High Nature Value farmland (Cooper et al. 2007).

48 Cooper, T., Arblaster, K., Baldock, D., Farmer, M., Beaufoy, G., Jones, G., Poux, X., McCracken, D., Bignal, E., Elbersen, B., Wascher, D., Angelstam, P., Roberge, J.-M., Pointereau, P., Seffer, J., & Galvanek, D. (2007). Final report for the study on HNV indicators for evaluation. Institute for European Environmental Policy, London

    - Cover of rye grasses and clover (and other agricultural grasses / cultivars according to national circumstances) less than [10%]; or
    - The sward is species rich, with more than [15] species/m^2; or
    - There is more than [30%] cover of herbs and sedges (excluding clover and undesirable species according to local circumstances).

The proposal may lead to significant impacts on land of high biodiversity value that need to be assessed by a Level 3 ESIA if:

- The site is within a recognised buffer zone for the protected area; OR

- At least two of the following apply to non natural grasslands on the site on the basis of the expert assessment:
    - Cover of rye grasses and clover (and other agricultural grasses / cultivars according to national circumstances) less than [20%]; or
    - The sward is moderately species rich, with [5] to [15] species/m^2; or
    - There is more than [20%] cover of herbs and sedges (excluding clover and undesirable species according to local circumstances).

- The site is of high biodiversity value, but this has arisen as a result of degradation [attributes and thresholds to be further defined].

- The site is undergoing ecological restoration and is likely to qualify as being highly biodiverse in future.

Otherwise, the site can be considered to have no restrictions on biofuel production with respect to grassland sustainability criteria.

Level 3: Expert Assessment

A more detailed expert assessment would be carried out as part of the ESIA process, in which all biodiversity impacts would be carefully evaluated according to recognised standards of good practice, for example CBD guidance on Ecological impact assessment (EIA) (CBD, 2006[49]).

[49] CBD (2006) Global biodiversity outlook 2 Secretariat of the Convention on Biological Diversity, Montreal.

ANNEX 7: SATELLITE DATA RESOURCES FOR WWF – LIST OF AVAILABLE SATELLITE DATA, SOURCES AND APPLICATIONS

The following tables and lists have been compiled by WWF Germany (Contact: Aurélie Shapiro, Remote Sensing Specialist WWF-Germany, aurelie.shapiro@wwf.de).

Low Resolution

Name	Source	Date	Resolution	Frequency	Spectral Bands	Uses, applications	Source
MODIS	NASA	1999 -	250m – 1km; ~10degree tiles	Twice daily	36 bands, for land, water, atmosphere	Fire detection, real time monitoring, daily snapshots, phenology, regional studies, long term trends, vegetation indices	Info on MODIS Data http://modis.gsfc.nasa.gov/data/ Search and download raw and derived data products from Reservb (need to register): http://reverb.echo.nasa.gov Or GLCF for derived products http://glcf.umiacs.umd.edu/data/modis
SeaWifs	NASA	1999-	9km	Daily	8 bands	Water quality, chlorophyll, sediment	Data download from Oceancolor web (registration required) http://oceancolor.gsfc.nasa.gov/
SPOT-VGT	VITO	2002-2012	1km	Daily	Red, blue, NIR, SWIR, Composite vegetation index	Surface mapping, basic vegetation and canopy	Read documentation for how to convert DN Background information: http://www.vgt.vito.be/index.html free products: http://free.vgt.vito.be/
MERIS/ ENVISAT	ESA	2002-2012	300m; swath width 1150km	3 days	15 bands	Land and water mapping	Data access through ESA application, multiple web clients: https://earth.esa.int/web/guest/data-access/catalogue-access

Medium Resolution

Name	Source	Date	Resolution	Frequency	Spectral Bands	Uses, applications	Source
ALOS PALSAR	JAXA	07-10	25m, 50m resolution	Annual mosaics	HH, HV polarization	Forest mapping, biomass, change detection, cloudy areas	Processed mosaics for Africa and SE Asia available in GTIFF from WWF Germany. HDF 50m mosaics can be download from the K&C website: http://www.eorc.jaxa.jp/ALOS/en/kc_mosaic/kc_map_50.htm Additional requests for 25m data can be made through K&C
ALOS AVNIR	JAXA	07-10	10m; 70km swath	2 days	Blue, green, red, NIR	Land cover mapping, and quick disaster response	Search archive and order through Pegasus: http://en.alos-pasco.com/sample/pegasus.html
ASTER	NASA	99-	15m/30m/90m; 60kmx60km tile	weekly	15 bands: 4 visible and NIR; 6 Short wave IR, 5 thermal bands (90m); 1 stereo	Land cover mapping, change detection, real time monitoring	Data can be browsed and downloaded from Earth Explorer http://edcsns17.cr.usgs.gov/EarthExplorer/ or Glovis http://glovis.usgs.gov list of ASTER Derived products: https://lpdaac.usgs.gov/products/aster_products_table
AWIFS	Indian Space Research Organization	03-	56m; 370 x 370km	5 days	4 spectral bands, green, red, NIR, Mid-IR	Land cover mapping, change detection, crop yields, large scale analyses	Data can be searched through the National Remote Sensing Centre of India http://218.248.0.130/internet/servlet/LoginServlet or through a reseller; data can be freely available for Amazon (Resource-Sat http://www.dgi.inpe.br/CDSR/)
Corona	USGS	60-72	10m; 22kmx22km	intermittent	Panchromatic camera	Historical mapping	Searchable via selecting Declassified Data in Earth Explorer: http://earthexplorer.usgs.gov/

Medium Resolution continued

ICESat/ GLAS	NASA	03-10	60m granules/footprints	891 days	LiDAR: Altimetry, backscatter	Forest canopy height, elevation, sea ice thickness	Coverage is not continuous; data must be filtered for quality. http://nsidc.org/data/icesat/index.html
KOMPSAT	Korea Aerospace Research Institute	2006-	1m panchromatic, 4m multispectral; 15km swath	14 days	Blue, green, red, NIR	Disaster surveillienace, vegetation and coastal monitoring	http://www.kari.re.kr/data/eng/contents/Space_001.asp?catcode=1010111000&depthno=0 imagery donations for climate change projects from www.planet-action.org
Landsat	USGS	1982 - 2012	30m; 185kmx185km	14 days	Red, Green, Blue, NIR, mid-IR, thermal IR (60m); Landsat 7 includes a panchromatic (15m) band	Land cover mapping, vegetation studies, change detection, long term studies, marine mapping	Landsat 7 ETM+ data collected after May 2003 has striping issues. Landsat 5 TM is still collecting, though not everywhere. Data can be browsed and downloaded from Earth Explorer http://earthexplorer.usgs.gov/ or Glovis http://glovis.usgs.gov

High Resolution

Name	Source	Date	Resolution	Frequency	Spectral Bands	Uses, applications	Source
CBERS I &II	China-Brazil	99-10	20,80, 240m; swath is 113-1000km	3-26 days	Panchromatic + red, infrared, blue, green, nir, shortwave and thermal infrared, stereoscopic	Multiple resolution forest monitoring, especially for Amazon	More information on the different CBERS satellites: http://www.cbers.inpe.br/ingles/satellites/cameras_cbers1_2_2b.php Free data for Amazon, some other countries available: http://www.dgi.inpe.br/CDSR/
IKONOS, Geoeye-1	GeoEye	99-	80cm-4m; 13km swath	On demand	Pan, blue, green, red, nir	Land cover mapping, marine mapping, high resolution detail, small area	Donation of 250km2 available from GeoEye Foundation www.geoeyefoundation.org Archive search online google interface, or ArcGIS toolbar http://geofuse.geoeye.com/landing/Default.aspx
Pleiades-1	Astrium	11-	50cm; 100kmx100km	daily	Green, blue, red, IR, panchromatic	High resolution mapping, validation	Data must be ordered through a reseller. Pleiades 2 will launch in 2012/2013
Quickbird, Worldview 1, 2	Digital Globe	01-	<60cm – 2.4m;	On demand	Red, green, blue, nir, panchromatic; worlview 2 has additional 4 bands: yellow, coastal, red edge, NIR 2	Land cover mapping, marine mapping, high resolution detail, small area, vegetation and biomass	Can be tasked on demand for $5.25/km2; archive orders start at 3.60 km2 View the archive at http://browse.digitalglobe.com/imagefinder/ upload a shapefile, change search criteria, download results
RapidEye	RapidEye AG	08-	6.5m 25km x 25km tiles; swath width 77km	daily	Blue, green, red, red edge, NIR	Land cover, vegetation mapping, change detection	Archive search at http://eyefind.rapideye.de/ Images available for free to research institutions in Germany
SPOT	Astrium	82	2.5-20m; 60kmx60km tile	2 days	Varies by satellite; pan, green, red, near IR, shortwave IR	Land cover mapping, vegetation and change detection	SPOT catalog: http://sirius.spotimage.com/PageSearch.aspx imagery donations for climate change projects from www.planet-action.org commercial SPOT imagery through regional reseller

INPE catalog with free imagery for Amazon: http://www.dgi.inpe.br/CDSR/

Other resources

For all imagery orders, please register as a GIS user on the portal first. You may also use the portal to order software, find data sources and other GIS, remote sensing users

WWF GIS portal: http://gis.panda.org

Useful table of derived products from MODIS and ASTER: https://lpdaac.usgs.gov/products

SPOT-VGT Vegetation archive 1km data: http://free.vgt.vito.be/

A number of derived products from Geoland 2, medium resolution, global coverage data: http://www.geoland2.eu/portal/service/ListService.do;jsessionid=C6BB68AAAE639ADBDA3AAAB05811CF4B?serviceCategoryId=CA80C981

Raw satellite data and derived products from the University of Maryland Global Land Cover Facility: http://glcf.umiacs.umd.edu/

3D land mapping with LiDAR and radar: http://lidarradar.jpl.nasa.gov/

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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