Implications of biofuel sustainability standards for Indonesia

White paper #4
Winrock International aims to support the efficient development of sustainable biofuels standards by assisting in providing access to relevant data on the technical, social, economic and environmental characteristics of biofuels.

Winrock International will develop three technical White Papers on GHG emissions, the role of water and building capacity to monitor standards. Three country impact evaluations of applying standards in national settings will be undertaken for the US, Brazil and Indonesia.

This country impact evaluation focuses on the implications of applying biofuel sustainability standards in Indonesia.

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1.0 EXECUTIVE SUMMARY

Over recent years, as energy security and environmental concerns have risen, there has been a substantial interest in biofuels and their potential contribution to energy security, mitigation of GHGs in the transport sector and also in delivering rural economic development benefits. Growing concern surrounding the sustainability of biofuels has led to numerous initiatives that attempt to define sustainability in the context of biofuels. Their aim is that, if adopted, these standards will deliver a sustainable outcome.

The majority of standards for biofuels or feedstock have been developed without a national context. This paper addresses the concept of biofuel sustainability in Indonesia and is specifically focused towards assisting organizations that are developing sustainability standards for biofuels. The aim is to support the effective development of sustainability standards through accessing information and interpreting impacts and outcomes in a specific national context. The report assesses the status of key issues and potential implications of applying sustainability standards in Indonesia, in terms of relevance, potential production locations and volumes and the capacity to implement and monitor standards.

The term biofuels can be used to cover solid biomass and liquid and gaseous fuels derived from biomass. This report is focused primarily on liquid biofuels. While there are many feedstocks for liquid biofuels, the scope of this paper is limited primarily to oil palm for biodiesel and sugarcane for bioethanol.

The report considers the following implications of sustainability standards
- Relevance of sustainability standards (based on market demand)
- Implications for production and planned production
- Relevance of standards for meeting national priorities on energy security and poverty alleviation
- Capacity building implications:

Relevance of market-based standards

Biofuels represent a significant strategic resource in Indonesia. As a net fossil fuel importer, and with substantial population growth and employment challenges, Indonesia’s main drivers for biofuels are to address national security through both energy security and poverty alleviation. Regional biofuel

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1 With the exception of the Roundtable on Sustainable Palm Oil (RSPO) that has developed national interpretations of generic principles and criteria.
production and use has local and national benefits that, given the distribution challenges and costs associated with a diverse archipelago, has a greater social relevance than environmental focus.

The relevance and benefit of implementing various international sustainability standards in Indonesia differs. Current biofuel policy in Indonesia focuses on a domestic market for biofuel in Indonesia, which reduces the relevance of international market-driven biofuel sustainability standards unless these standards are seen to provide some other benefit e.g. they improve economic returns for projects. However, these standards will likely impact crude palm oil (CPO) production and export as a biofuel feedstock because it is expected to make a significant contribution to the biofuel feedstock mix internationally (and particularly within the EU). Internationally, it is estimated that around 5% of CPO is used for biofuel production. Applying this statistic to Indonesia would mean that 0.6MT of CPO may be impacted by global biofuel sustainability standards which would represent a value of around US$0.4m. Assuming an average of 2.73tCPO/ha, the 0.6MT would represent around 220,000ha.

However, the potential CPO equivalent of all EU biodiesel imports in 2020 could be 3.32MT based on EU calculations. If 50% of this was sourced from Indonesia it would represent 14% of the country’s 2007 export volume and would translate to an impact on 0.6Mha, which is approximately 9% of the 6.3mha reported by IPOB, 2008) as cultivated in 2007.

Until recently the main potential feedstock for ethanol in Indonesia was assumed to be molasses since Indonesia produced less granular sugar than it consumed. This seems to be changing though, as the Government of Indonesia is advocating development of sugar cane solely for ethanol in its Biofuel Development Plan (although this contrasts with its stated aim of becoming self sufficient in sugar). EU legislation that defines mandatory sustainability criteria for biofuels sold in the EU will impact CPO initially and any other feedstocks and biofuels that are intended for European consumption.

Indonesian Government subsidies on fossil fuels create problems of economic viability for biofuels. Without subsidies ethanol from sugarcane is more competitive against gasoline under most scenarios for cost of cane production. Subsidies for gasoline change this situation and ethanol is only competitive when cane costs are low. For biodiesel, which is only competitive against relatively high unsubsidized fossil diesel prices, subsidies on diesel only worsen its competitiveness. The government is proposing a subsidy for domestically used biofuels to boost the domestic market. Proponents of the subsidy suggest that the use of CPO for domestic biodiesel use will increase the price of CPO internationally which will increase tax revenues from CPO exports. If the export price were, for example, US$850/t the resulting tax revenue would subsidize 5 billion liters of biodiesel (6MT of CPO) which is equivalent to a blend of 20% biodiesel based on 2007 fossil diesel demand and matches the domestic biodiesel goal for 2025. At present, the biofuel subsidy is not linked to any social or environmental criteria for biofuels.

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2 See Figure 3-1 in http://www.renewablefuelsagency.org/_db/_documents/Ecofys_Review_of_EUIA_on_biofuel_targets.pdf
Assumes all imports met by palm biodiesel. 0.95tonnes biodiesel per tonne palm olein and 0.8tonnes palm olein per tonne CPO.
Sustaining current food production and expanding biofuels relies heavily on the price and availability of fertilizer. In 2015, an estimate of 2.8 million tonnes of urea for biofuels alone (Bahan Bakar Nabati, 2006) is equivalent to the total consumption in Indonesia of around 3 million tonnes of all fertilizer (2002 latest data). Low natural gas prices in Indonesia have supported low cost urea production but competition for natural gas supply threatens domestic availability and prices of fertilizer. Fertilizer cost is one of the main drivers of oil palm production cost and higher prices could further threaten competitiveness of biodiesel. Fertilizer for sugarcane is subsidized and higher prices may be absorbed by the subsidy but could mean further pressure on State budgets and threatens economic sustainability. Alternative approaches to fertilizer such as agricultural by-product recycling and composting is gaining popularity and will reduce availability of lignocellulosic residues for any advanced (sometimes referred to as second generation) biofuel production.

**Potential areas of production that meet high level environmental criteria**

Given the relatively substantial impact of sustainability standards on oil palm and their potential significant future impact on sugarcane, a GIS analysis was conducted that combines spatially explicit data to obtain the geophysical suitability of land for oil palm and sugarcane excluding land that key risk criteria in biofuel sustainability standards preclude the use of. We have termed the remaining land “geophysiscal plus”. Land types excluded by these key risks are:

- Forested areas
- Peatlands
- Protected areas³
- Land at risk of erosion

Annex 1 details the datasets and methodology.

The implication of applying high level sustainability criteria with an emphasis on avoiding high carbon stocks and protecting sensitive areas does not mean that Indonesia’s ability to meet domestic and potentially international biofuel demands is necessarily inhibited. However, data limitations on social issues, such as land rights, limit the robustness of such techniques to evaluate impacts for key policy drivers of poverty alleviation and socio-economic development. The results should therefore be viewed as providing a broad-brush perspective for guidance with finer level work still required.

The geophysically potential land suitable for oil palm cultivation throughout Indonesia is approximately 92Mha. Applying high level sustainability criteria reduces the amount of potentially suitable land by 67Mha (73%) to around 25Mha. Based on this remaining ‘geophysical plus’ potential in each region of the country, the average productivity for each region published by IPOB (2008) and an assumption of

³ Note: Protected areas are used as a proxy for areas of high biodiversity. In many cases a High Conservation Value approach is advocated to establish environmental and social conservation areas but this was beyond the scale and scope of this study. Details of HCV areas in Indonesia are available from (WWF, 2005; Wijaya, et al., 2008) and further information on HCV areas www.hcvnetwork.org
854 liters biodiesel/t CPO, the potential ‘geophysical plus’ area could produce around 53 billion liters of biodiesel. Discounting areas of existing oil palm would result in a potential of 38.4 billion liters of biodiesel. This compares to a fossil diesel demand of approximately 26 billion liters. At a blend of 20% biodiesel (the domestic goal for 2025) the domestic requirement of around 5 billion liters would mean the biodiesel available for export would be in the region of 33 billion liters. With increased yields to 4tCPO.ha, the additional biodiesel production could potentially be 63 billion liters. These calculations assume that suitable land is available for production and all of the oil is used for biodiesel production. The actual production will be lower. However, meeting domestic demand for biodiesel while exporting significant quantities of biodiesel all produced in a sustainable manner is feasible.

The geophysically potential land suitable for sugar cane throughout Indonesia is approximately 57Mha. Applying high level sustainability criteria to the geophysical potential for sugarcane reduces the potentially suitable land (‘geophysical plus’) for sugarcane by 39.6Mha (69%) to around 18Mha. Some potential sugarcane land is on rice paddy areas. There are 12,147,637ha of rice paddy land nationally. Removing this entire area from the ‘geophysical plus’ category and accounting for existing production reduces the available potential area to 4,918,730ha, which can produce approximately 27.5 billion liters of bioethanol (assuming yield of 65t cane/ha.yr and 86 liters/t cane) which is equivalent to around 20 billion liters of gasoline on an energy basis. This amount of bioethanol still surpasses current gasoline demand of 18.7 billion liters. At an E15 blend (national 2025 goal) this would require 2.8 billion liters (on a volumetric basis) and potentially therefore allow an export of 24.6 billion liters. Higher yields of cane at 80t/ha.yr on the additional potential area would produce approximately 34 billion liters of bioethanol per year.
Figure A: Areas of ‘geophysical plus’ potential and existing oil palm concessions

Figure A illustrates that much of existing oil palm concessions are located on areas that are deemed ‘unsustainable’ by sustainability criteria established in the EU biofuels directive, but other areas within the concessions appear uninhibited by such criteria. In the main oil palm growing regions, the areas within current concessions that are classified under the ‘geophysical plus’ potential are Jambi – 292,760 ha, Riau – 337,595 ha, Kalimantan – 1,137,860 ha. There are substantial areas outside concession areas that are classified as ‘geophysical plus’ potential. However, key data limitations on land rights or highly biodiverse areas (other than protected areas) limit the robustness with which such conclusions around sustainability can be made.

Existing application of sustainability criteria in biofuel planning

The GIS analysis illustrates that areas of potential supply of biofuel feedstock on ‘geophysical plus’ areas do not necessarily match availability of suitable infrastructure and will heavily influence economic viability e.g. Special Biofuel Zones defined for Papua. Figure B illustrates that existing
plans for expansion of oil palm land are greater than the ‘geophysical plus’ potential in some provinces, a fact unlikely to have been considered in development planning.

**Figure B: Planned expansion area of oil palm to 2020 and ‘geophysical plus’ potential (ha)**

Source: Colchester, et al., 2006 for the planned expansion data

GHG emissions and loss of biodiversity from land use changes are one of the largest concerns surrounding biofuels from oil palm in Indonesia. Effective land use planning can play a significant role in avoiding these risks and the most immediate and effective route is to engage and collaborate with private and public organizations with large land concessions to effectively plan the land use for optimal economic, environmental and social benefit. Table A, for example, illustrates significant land holdings of around 3.9Mha are yet to be developed and could be positively impacted by land use planning for expansion of oil palm plantings.
Table A: Land holdings and oil palm area of key private sector groups in Indonesia

<table>
<thead>
<tr>
<th>Company/ group</th>
<th>Land bank (ha)</th>
<th>Planted area oil palm (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golden Agri/SMART</td>
<td>1,300,000</td>
<td>359,732</td>
</tr>
<tr>
<td>Indofood Agri Resources</td>
<td>570,000</td>
<td>374,000</td>
</tr>
<tr>
<td>Asian Agri</td>
<td>515,000</td>
<td>170,000</td>
</tr>
<tr>
<td>Wilmar International</td>
<td>573,000</td>
<td>n/a</td>
</tr>
<tr>
<td>Astra International</td>
<td>500,000</td>
<td>238,000</td>
</tr>
<tr>
<td>Minamas Gemilang</td>
<td>288,000</td>
<td>n/a</td>
</tr>
<tr>
<td>Ciliandra Group</td>
<td>278,000</td>
<td>86,000</td>
</tr>
<tr>
<td>Bakrie Sumatra Plantation</td>
<td>210,000</td>
<td>78,000</td>
</tr>
<tr>
<td>Tri Putra Agro Persada</td>
<td>200,000</td>
<td>120,000</td>
</tr>
<tr>
<td>Bumitama Gunajaya/ Harita Group</td>
<td>200,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Duta Palm Group</td>
<td>200,000</td>
<td>54,000</td>
</tr>
<tr>
<td>Lyman Agro</td>
<td>190,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Sampoerna Agro</td>
<td>182,000</td>
<td>78,000</td>
</tr>
<tr>
<td>Incasi Raya Group</td>
<td>174,000</td>
<td>36,000</td>
</tr>
<tr>
<td>Golden Hope</td>
<td>170,000</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total undeveloped oil palm (ha)</strong></td>
<td><strong>3,866,268</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Jakarta Globe, 2009

Potential social benefits of biofuels

Forty five percent of remote villages in Indonesia have minimum access to roads, education, health, electricity and national distribution of fuel oil (Widodo & Rahmarestita, 2008). The difficulty associated with transportation to remote locations has huge implications for prices of fuels and, in turn, on poverty. In addition, there are more than 5 regions where connection costs are almost 50% greater than the potential revenues (Indoneisan Institute for Energy Economics, 2007) and the state electricity company, PLN, will be unwilling to invest in grid connections. Significant opportunities exist for local off-grid developments (for community electrification, schools etc) through integration with local biomass & biofuel resources, for example from local palm oil processing (biogas) or straight vegetable oil as energy sources provide such opportunities.

Oil palm is estimated to supports up to 57% of the population of Riau and 10% to 50% of the population in an additional 11 regions, including over 45% in Jambi and Kalimantan Tengah (Figure C).
These social benefits could be delivered with GHG benefits. In 2007 there were 421 palm oil processing facilities in Indonesia with a combined capacity of 18,343t FFB/hour. Without methane capture this could contribute approximately 13-16 million tonnes CO$_2eq$/yr in GHG emissions. This is a substantial addition to GHG emissions in Indonesia and represents around 17% of the emissions from power plants (93 million tonnes in 2007), around 24% of emissions in the transport sector (67.7mt in 2005) and more than twice the emissions associated with gas flaring (7mt in 2000).\(^4\) Biogas capture and by-product utilisation could contribute to rural electrification but energy supply does not always match local demand and may not justify investment costs.

The lack of institutional capacity and legal framework to address land rights limits the ability to develop regionally appropriate bioenergy models. In this instance sustainability standards that

address land rights are relevant but are limited in scope. Therefore, capacity at the local level to address these issues in the planning stage is critical.

**Technical strength of government and research institutions to undertake monitoring**

The implementation of biofuel policy and standards is highly influenced by political and regional geographies. Government institutions have a key role to play in delivering a sustainable biofuel policy but there are so many institutions involved with conflicting priorities that a lack of coordination will jeopardize the development of a biofuel industry and implementation of standards. Decentralized political control means that, despite any agreements that might be made at the national level on biofuel sustainability criteria, decisions are made at the provincial level and therefore effective solutions for biofuel sustainability should engage regional institutions. There is also a lack of coordinated bioenergy research agenda and dedicated bioenergy research center to assist in developing regionally appropriate bioenergy models.

The development and use of GIS techniques could support effective development of sustainable biofuels by providing accurate and reliable data and information on with respect to land use and land cover as well as biodiversity and water. The lack of digitized information for key issues limits the potential use of GIS techniques and it appears that while Ministry of Forestry may have most experience in this area, capacity is required to be built within other departments (such as the Ministry of Agriculture) that have a key role to play in biofuel development and deployment.

Strength of institutions to undertake planning and monitoring is compromised by land classification systems and associated governance issues. For example, the term ‘alang-alang’ is often used as a proxy for ‘degraded’ land that was previously forested. However, if the alang-alang is administratively classified as ‘Forest land’ it is under the control of the Ministry of Forestry. It may have been forest in the 1970s but is now degraded and could be classified as ‘conservation forest’ or ‘productive forest’. In these classifications only forestry activities can be developed – this land cannot be used for agricultural purposes unless permission has been granted by Ministry Forestry and subsequently the reallocation has taken place. The time it takes to grant the conversion is often more than project risk can bear.

Institutional strength and capacity outside governments are growing as stakeholder experience with the Roundtable on Sustainable Palm Oil (RSPO) is large and growing. While several large plantations have been certified, smallholders are not currently certified. Without additional resources and effort to build capacity within smallholder farming systems to meet standards (consistently), the implications of applying standards could have a negative impact on socio-economic goals. There is a major role here for information dissemination through technology and networking. Provincial activities will play a key role and could provide the necessary anchors for technical advisory services as well as local resource inventories to establish locally appropriate feedstocks.
Availability of data to undertake necessary & relevant analysis and planning

Information needs to be transparent and accessible for monitoring purposes. Obtaining data in Indonesia is relatively difficult and useful maps may be expensive to purchase, but in many cases geospatial data may not be available at regional levels. There is a role for technologies such as remote sensing and GPS to assist in developing baseline maps for example, but there is increasingly a need for spatial information related to other key criteria e.g. sustainable water use can really only be understood and delivered with location specific information. Mapping customary land use systems with GPS and GIS methodologies has been demonstrated in Indonesia but accurate base maps are not always available in order to make good use of this approach.

National level data used to assess sustainability risks in Figure A is freely available for use in high level analyses to indicate some sustainability risks and issues for biofuels but is at too coarse a scale to draw detailed conclusions. Ready interpreted national land cover information for the period of 2008 that will be required for some standards (such as the EU mandatory criteria) was not available for this study which used land cover from 2003/5. Regular production of such data and transparency in its production will be key to monitoring. In addition, some data may be misleading (e.g. land classification versus land cover). National scale and provincial scale maps are likely to be different and do not necessarily map what ‘is’ but rather what ‘shall be’, which are significant issues for effective planning with sustainability criteria.

Table B: Summary of the implications of applying biofuel sustainability standards in Indonesia (high impact to low impact)

<table>
<thead>
<tr>
<th>Relevance</th>
<th>Status</th>
<th>Potential</th>
<th>Capacity for compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevance of international market-based sustainability standards</td>
<td>Existing application of sustainability criteria for biofuels (and feedstock)</td>
<td>Potential area of production that meet high level environmental sustainability criteria</td>
<td>Technical strength to undertake planning &amp; monitoring including using GIS applications</td>
</tr>
<tr>
<td>High</td>
<td>X (exported)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Low</td>
<td>X (domestic)</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

X (exported)
2.0 INTRODUCTION

Over recent years, as energy security and environmental concerns have risen there has been a substantial interest in biofuels and their potential contribution to energy security, mitigation of greenhouse gases (GHGs) in the transport sector and also in delivering rural economic development benefits.

The benefits of promoting biofuels have been challenged in recent years by some non-governmental organizations and scientists. In some cases the intended benefits have not been delivered and instead, negative consequences, such as land grabbing and increased GHG emissions, have been reported.

In recognition of the desire to ensure intended benefits are delivered there are numerous organizations, alliances and policy-makers involved in developing standards for liquid biofuels and biofuel feedstock production. Some of these standards serve as tools for guiding public policy decisions at the national level (such as taskforces under the Global Bioenergy Partnership), while others are intended for application at the field or project level (i.e. voluntary standards such as the Roundtable on Sustainable Palm Oil (RSPO) or mandatory criteria in the EU Renewable Energy Sources Directive). These standards are currently at different stages in their development; some are being implemented and others are just at the initial stages of sustainability criteria development. Their aim is that, if adopted, these standards will deliver a sustainable outcome for biofuels production and use.

The biofuel industry in Indonesia is nascent but policies exist to increase its share to 15% of the gasoline market and 20% of diesel market (as well as in electricity) by 2025. By contrast, the international biofuel market has grown substantially in recent years and Indonesia has contributed to meeting these demands by supplying palm oil, which is a key biofuel feedstock. The use of crude palm oil (CPO) for biodiesel is anticipated to represent only around 5% of the CPO produced in the world currently but this share is expected to increase with mandates, such as the 10% by energy content in the EU by 2020.

In January 2008, the European Parliament agreed that biofuels must represent 10% by energy of Member States transport fuel sales and that the biofuels must meet several criteria in order to count towards these targets. These criteria are that biofuels:

- Represent at least 35% GHG emission reduction compared to fossil fuel (increasing to 50% reduction by 2017)
- Conserve carbon stocks. Include no raw material from:
  - wetlands that are covered with or saturated by water permanently or for a significant part of the year; or
“continuously forested area”, defined as >1 hectare with trees higher than 5 metres and a canopy cover of more than 30%, or trees able to reach these thresholds in situ; or >1 hectare with trees higher than 5 metres and a canopy cover of between 10% and 30%.

- Conserve biodiversity. Include no raw material from:
  - forest undisturbed by significant human activity;
  - highly biodiverse grassland; or
  - nature protection areas.

Biofuels can receive a GHG bonus of 29gCO2eq/MJ under the EU criteria for production on degraded land and can therefore contribute to the minimum cut-off of 35% GHG saving. The credit is attributed if evidence is provided that the land was not in use for agriculture or any other activity in January 2008 and falls into one of the following categories: (i) severely degraded land, including such land that was formerly in agricultural use; (ii) heavily contaminated land.

Some of these terms (such as ‘highly biodiverse grassland’ or ‘significant’) have not yet been defined in order to enable practical application. Work is currently underway to develop guidelines and identify data sources that will assist in compliance with these criteria.

There are also voluntary roundtables that exist which develop standards that cover sustainable biofuels or biofuel feedstock. For example, the RSPO is focused on oil palm as a commodity and not specifically as a biofuel feedstock. It is the most advanced of the international biofuel related commodity standards and relevant for a globally traded commodity such as palm oil. A national interpretation of the principles and criteria developed in Indonesia has enabled the first companies to become certified under the RSPO. Many companies in Indonesia have stated that they wish to comply only with one sustainability standard - the RSPO – rather than be faced with a multitude. Current challenges that the RSPO face include the lack of attention to GHG emissions within the standard, which is a key issue for biofuels (a new working group in the RSPO is attempting to address this). Related to this is a concern that certification currently allows new plantations on peatlands of <3m depth, provided water table management is practiced. This may be incompatible with the EU scheme, but details on whether this certification standard will be accepted by the EU have not yet been developed.

More recently, the Roundtable on Sustainable Biofuels (RSB) has developed Version Zero principles and criteria for sustainable biofuels that are intended to be developed into a certification scheme. The RSB will benchmark other standards (such as the RSPO) against its own to determine whether they meet the requirements. RSB intends, therefore, not to replace other standards but will enable certification of ‘missing criteria’ relevant for biofuels, such as those related to GHG emissions.

Mandatory sustainability criteria in the EU and a growing move to establish criteria within project financing institutions will affect the development of some projects in Indonesia. Initial impacts will be on export markets for CPO, but these standards will also potentially impact domestic projects that
require international financing. These standards are designed to either mitigate negative impacts of biofuel expansion or to promote ‘better’ management practices.

2.1 Summary of sustainability standards for biofuels

**Table 1: Summary of sustainability standards relevant for biofuels and/or feedstocks** *(This list is not exhaustive and is for indicative purposes only as details within criteria differ)*

<table>
<thead>
<tr>
<th>Criteria/Standard</th>
<th>European Directive (REsD)</th>
<th>UK Roundtable Sustainable Biofuels</th>
<th>Better Sugarcane Initiative</th>
<th>Roundtable on Sustainable Palm Oil</th>
<th>Roundtable on Responsible Soy</th>
<th>Sustainable Biodiesel Alliance</th>
<th>Sustainable Agriculture Network (biofuels addendum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory (M) / Voluntary (V)</td>
<td>M V V V V V V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft (D) / Agreed (A)</td>
<td>A A D D A A A</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Legality</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Follow all applicable laws of the country</td>
<td>- ✓ - ✓ ✓ ✓ ✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Consultation, planning &amp; monitoring</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design &amp; operated projects under appropriate, comprehensive, transparent, consultative, and participatory processes that involve all relevant stakeholders</td>
<td>- - ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Land rights</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biofuel production shall not violate land rights</td>
<td>- ✓ ✓ ✓ ✓ ✓ -</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free Prior and Informed Consent</td>
<td>- ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Climate change / Conservation of carbon</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce GHG emissions as compared to fossil fuels</td>
<td>✓ ✓ ✓ - ✓ ✓ ✓ ✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conserve above and below ground carbon stocks</td>
<td>✓ ✓ - ✓ ✓ ✓ - -</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Human &amp; labor rights</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No violation of human rights or labor rights, ensure decent work and &amp; well-being of workers</td>
<td>- ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rural &amp; social development</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contribute to the social and economic development of local, rural and indigenous peoples and communities</td>
<td>- - ✓ - ✓ ✓ ✓ ✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Food security</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biofuel shall not impair food security</td>
<td>- - ✓ - - - - -</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conservation &amp; biodiversity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoid negative impacts on biodiversity &amp; ecosystems</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>
### 3.0 Scope and Aim of the Report

The majority of standards for biofuels or feedstock have been developed without a national context (with the exception of the RSPO). This paper addresses the concept of biofuel sustainability in Indonesia and is specifically focused towards assisting organizations that are developing sustainability standards for biofuels. The aim of the report is to support the development of effective sustainability standards through accessing relevant information and interpreting impacts and outcomes in a specific national context.

The report assesses the relevance of standards to Indonesian biofuels and/or feedstock, the status of key issues and potential implications of applying sustainability standards in Indonesia, both in terms of potential production locations and volumes and its capacity to implement and monitor standards.

The term biofuels can be used to cover solid biomass and liquid and gaseous fuels derived from biomass. This report is focused primarily on liquid biofuels. While there are many feedstocks for liquid biofuels, the scope of this paper is limited primarily to oil palm for biodiesel and sugarcane for bioethanol.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>European Directive (RESD)</th>
<th>UK</th>
<th>Roundtable Sustainable Biofuels</th>
<th>Better Sugarcane Initiative</th>
<th>Roundtable on Sustainable Palm Oil</th>
<th>Roundtable on Responsible Soy</th>
<th>Sustainable Biodiesel Alliance</th>
<th>Sustainable Agriculture Network (biofuels addendum)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil</strong></td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Air</strong></td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Economics</strong></td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Note: Some criteria noted with a dash in this table are addressed within standards but have not stated a performance indication e.g. minimize.
Approach
To assess potential implications of applying sustainability standards a qualitative and quantitative approach has been taken. The study and supporting data are based on interviews with, and research from, Indonesian stakeholders as well as published peer-reviewed literature and datasets. The study attempts to illustrate how techniques to determine sustainability outcomes (such as GIS analysis) can be used and applied in Indonesia, to identify the extent to which these techniques can be used to draw conclusions related to biofuels and to identify the capacity in Indonesia to implement such techniques.

Sections 4.0 and 5.0 set the context for assessing the relevance of biofuels sustainability standards within Indonesia with respect to Indonesia’s priorities and policies.

Section 6.0 assesses the extent to which the application of specific environmental sustainability criteria impact Indonesia’s production plans. To support the work, a GIS analysis of the geophysical potential of two key biofuel crops (sugarcane and oil palm) at a national scale was conducted and complemented by data obtained from experts and published literature. The GIS analysis of geophysical potential also excluded land with key sustainability criteria identified in many standards. The latest land cover dataset that was available for this study was 2003/5. The result of this land availability is termed the ‘geophysical plus’ potential throughout the report (See Annex 1 for methodology).

The exclusion areas identified are:
- Forested areas
- Peatlands
- Protected areas\(^5\)
- Land at risk of erosion (water)

Section 7.0 discusses environmental, social and economic issues for biofuels in Indonesia. It attempts to assess a) how these issues impact on the priorities of Indonesia (and are therefore somewhat related to the relevance aspect of sustainability standards), b) the existing application of criteria to address these issues in Indonesia, c) the technical strength of government and other relevant institutions to address the issues and d) the availability of data to assist compliance and monitoring.

\(^5\) Note: Protected areas are used as a proxy for areas of high biodiversity. In many cases a High Conservation Value approach is advocated to establish environmental and social conservation areas but this was beyond the scale and scope of this study. Details of HCV areas in Indonesia are available from (WWF, 2005; (Wijaya, et al., 2008) and further information on HCV areas www.hcvnetwork.org
4.0 PRIORITIES FOR BIOFUELS IN INDONESIA

4.1 National Energy security

Indonesia relies significantly on crude oil and its products for energy purposes (supplies 73% of total primary energy). Indonesia’s proven oil reserves however, in contrast with other Asia-Pacific nations, have reduced substantially over the past 20 years.

**Figure 1: Proven oil reserves in Asia Pacific (end 1987 to end 2006)**

![Proven oil reserves graph](image)

Source: Indonesian Institute for Energy Economics, 2007

**Figure 2: Primary energy consumption in Indonesia (mtoe)**

![Primary energy consumption graph](image)

Source: APERC, 2006
Indonesia has also recently become a net importer of fossil fuels, whereas it has been a significant exporter for many years (See Figure 3). Fossil fuels are heavily subsidized in Indonesia and represent a substantial portion of the state budget; 15.8% in 2005 and 8.4% in 2006 (Indonesian Institute for Energy Economics, 2007). This substantially reduces government funds available for health care and education, for example. While the level of subsidy is impacted by world oil price, it is also affected by the substantial distance from production to consumption in the archipelago. Supply disruption is common and can affect local economic development and social well-being. While dependence on fossil sources is high, natural biomass resources are abundant and their use for power or transport is of significant strategic value in Indonesia for poverty alleviation and rural economic development.

Figure 3: Oil production and consumption in Indonesia 1965–2007 (thousand barrels oil per day)

4.2 Socio-economic development and poverty alleviation

Forty five percent of remote villages have minimum access to roads, education, health, electricity and national distribution of fuel oil (Widodo & Rahmarestia, 2008). The difficulty associated with transportation to remote locations has huge implications for prices of fuels and, in turn, on poverty. As an example, in Wamena Papua the free market price of household kerosene is Rp 20,000/liter (US$2/l), while the highest allowable price is Rp 2,300/liter (US$0.23/l) (Widodo & Rahmarestia, 2008) and therefore substantial subsidies are required.

Grid electricity connection for local communities in some areas is unlikely to be available in the foreseeable future due to high cost that PLN, the state electricity company, would incur. There are substantial subsidies.

It costs as much as US 17 cents/kWh for a connection in Maluku but with potential revenues in the same region of only US cents 7.5/kWh.
more than five regions where connection costs are almost 50% greater than the potential revenues (Indonesian Institute for Energy Economics, 2007). In these regions, significant opportunities exist for local off-grid developments (for community electrification, schools, etc.) through integration with local biomass and biofuel resources. These include biogas to energy from local palm oil processing, generators running on straight vegetable oil (SVO), use of small scale ethanol plants to provide a gasoline substitute or for use to convert SVO to biodiesel. Village based schemes that combine these energy sources with wind and solar are especially attractive to isolated communities.

The link between food security and biofuels in Indonesia is a complex one but in some cases has been simply discussed on the basis of competition for land between food or fuel. In Indonesia food security for many communities is directly related to their economic situation (the affordability aspect of food security) due to reliance on expensive fossil fuels. Biofuels could play a positive role in food security issues for these communities by reducing their reliance and expenditure on fossil fuels (e.g. water pumps run of SVO or tractors on biodiesel).

4.3 Employment

In 2007, Indonesia’s population was roughly 235 million, making it the third most populous nation in the Pacific Rim (behind China and the United States). Population increases in Indonesia have been significant and are expected to remain so in the future. One study projects an increase from 205.1 million in 2000 to 273.1 million in year 2025 (Bappenas; BPS; UNFPA, 2005). On average this means an extra 2.7 million people per year will require jobs, food, energy and water.

The unemployment rate in Indonesia is reportedly falling year on year, and in August 2008 the unemployment rate was 8.4% compared to 9.1% in August 2007 (these figures were reported in the run-up to a general election). However, the challenge of creating employment for such a rapidly rising population is real.

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005 (Feb)</th>
<th>2006 (Feb)</th>
<th>2007 (Feb)</th>
<th>2008 (Feb)</th>
<th>2009 (Feb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment Rate (%)</td>
<td>9.86</td>
<td>10.26</td>
<td>10.45</td>
<td>9.75</td>
<td>8.46</td>
<td>8.14</td>
</tr>
</tbody>
</table>

Source: BPS

4.4 Other environmental benefits

Air quality is a significant issue in Indonesia. Combustion of fossil fuels for power and transportation is causing significant deterioration in local air quality in many of Asia’s largest cities, several of which have particulate pollutant levels (PM) that are three to four times the acceptable levels set by the World Health Organization (WHO). Total suspended particulates, PM$_{10}$ and N$_2$O, are all greater in Jakarta than current WHO limits. Biofuels offer the potential to mitigate some of this pollution as in some cases they have lower tailpipe PM$_{10}$ emissions than fossil fuels and generally lower volatile
organic compounds (VOCs) emissions. Some biofuels may have higher nitrous oxide (NOx) tailpipe emissions than fossil fuels and emissions from vegetation burning are another environmental issue associated primarily with oil palm in Indonesia which causes severe smog across parts of Southeastern Asia and has associated impacts on human health. If vegetation burning emissions are avoided, one study suggests that a switch from fossil to biofuels may benefit local air quality in Asia (IRG, 2009).

5.0 BIOFUEL POLICY

The term 'biofuel' in Indonesia is commonly used for both liquid fuels for transport, heat and power production as well as solid biomass fuel.

Since 1967, Indonesia has been subsidizing the retail price of transport and cooking fuels (Dillon, Laan, & Dillon, 2008), and increasing oil prices represent substantial parts of the annual state budget. In 2005, the subsidies represented 15.8% but reduced to 8.4% in 2006 (Indonesian Institute for Energy Economics, 2007). With prices moving to record levels in 2008, the proportions will be expected to increase again.

The Presidential Decree (No 5/2006) on National Energy Policy (Kebijakan Energi Nasional) was issued in response to rises in fossil fuel prices and their significant impacts on the state budget. It sets national targets for an optimal energy mix in 2025. These targets reduce oil consumption while increasing that of coal and gas. The biofuel targeted contribution is 5% of the overall target for renewable energy. It refers to biofuel for stationary as well as mobile applications (see Figure 4).

Indonesia’s vision for its biofuel policy is to address national security issues by creating employment and alleviating poverty while reducing dependence on fossil fuel. Presidential Decree No.10 of 2006 established a National Team for Biofuel Development for Accelerating Poverty Alleviation and Job Creation (Timnas BBN). The mandate of the team was to formulate a blueprint for biofuel development. It had an advisory rather than implementation role. Documentation produced by the National Team provided the vision and strategy for the country, but the Team had no power to implement their strategy. The requirements to achieve its vision, such as land allocation, require the engagement and participation of different Ministries. Table 10 illustrates the part each Ministry plays in delivering the biofuel strategy.

Targets identified for 2010 by the National Biofuel Development Team include

- Job creation for 3.5 million people
- Increased income for 3.5 million people on-farm and off-farm (at least minimum regional wage standard)
- Development of 5.25 million ha of biofuel cropland (1.5 million ha palm, 1.5 million ha jatropha, 1.5 million ha cassava, 750,000 ha sugarcane) on currently uncultivated land
- The creation of 1,000 Energy Self Sufficient Villages by 2010 (see Box 1)
- Creation of 12 Special Biofuel Zones

Document produced by the National Team provided the vision and strategy for the country, but the Team had no power to implement their strategy. The requirements to achieve its vision, such as land allocation, require the engagement and participation of different Ministries. Table 10 illustrates the part each Ministry plays in delivering the biofuel strategy.
- Approximate savings of US$10 billion from national reserves
- Domestic self sufficiency in addition to export availability

**Figure 4: Targets for Indonesia’s energy mix in 2025 compared to 2006**

Source: Legowo, 2009

**Box 1: Energy Self Sufficient Villages**

Reducing the exposure of the rural poor to such volatile fuel prices is the aim of the Energy Self Sufficient Villages. The plan envisages creating 1 000 energy self-sufficient villages by 2010, and approximately 123 are reported to be under implementation. Villages are plasma units that cultivate around 50 hectares of biofuel feedstock crops. A “nucleus” processing facility is intended to purify the oil to produce a fuel-grade product that could be blended with petroleum fuels and used locally (Dillon, Laan, & Dillon, 2008).

In October 2008, the Indonesian Government passed legislation that makes biofuel consumption mandatory. Blending percentages differ between Public Service Obligation (PSO) transportation fuels, which are subsidized and only allowed to be sold by Pertamina (the State run oil company), compared to non-PSO transportation fuels which are not subsidized and can be sold by Pertamina or any of the increasing number of commercial filling stations (such as Shell). For transportation fuels, the obligation is placed on the supplier of the fuel. The ultimate penalty for failure to comply with the
mandate is revocation of the licence to operate but in the case of Pertamina, the State-owned fuel supplier, this is particularly challenging. Revoking a licence to operate for the main fuel distributor in the country is not a real option.

**Table 3: Biofuel blending requirements in Indonesia from 2009**

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BIOETHANOL (Min)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation (PSO)</td>
<td>1%</td>
<td>3%</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>Transportation (Non PSO)</td>
<td>5%</td>
<td>7%</td>
<td>10%</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td>Industry</td>
<td>7%</td>
<td>10%</td>
<td>12%</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td><strong>BIODIESEL (min)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation (PSO)</td>
<td>1%</td>
<td>2.50%</td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>Transportation (Non PSO)</td>
<td>1%</td>
<td>3%</td>
<td>7%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>Industry</td>
<td>2.50%</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Electricity</td>
<td>0.25%</td>
<td>1%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Straight vegetable oil</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Industry &amp; transport (industry &amp; marine)</td>
<td>2%</td>
<td>6%</td>
<td>10%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Electricity generation</td>
<td>0.25%</td>
<td>1%</td>
<td>5%</td>
<td>7%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Note: PSO (public service obligation) refers to subsidized fuels
**Current status of biofuels in Indonesia**

By the end of 2010, biodiesel requirements for transport are estimated to be 2.41 billion liters (Bahan Bakar Nabati, 2006). By the end of 2008, installed biodiesel capacity reached around 2.6 billion litres and therefore is theoretically sufficient to meet 2010 demand. However, if CPO price is high, the output of biodiesel will likely be below requirements owing to lack of economic viability. Many plans are available that project large capacity increases, but, with financial circumstances at the time of writing, future increase to meet the forecast transport biodiesel demand of 4.52 billion liters in 2015 is uncertain. By the end of 2010, bioethanol requirements are estimated to be 1.48 billion liters, but installed capacity is currently only 0.2 billion liters. Again, plans illustrate potentially large increases in capacity, but no physical building is underway yet. With an estimated time of 2 years for a plant to come on stream, bioethanol demand can not be met internally by 2010.

Special incentives for investors were announced by the Government including, as a reduction in stamp duties, relief from import duties for goods used in the production of biofuels, an investment tax allowance and an exemption from the Value Added Tax for selected strategic goods (Dillon, Laan, & Dillon, 2008). Despite this, there has been no apparent growth in the industry to meet planned future mandates and national energy security goals are compromised. The future of the biofuel industry and its expansion plans in Indonesia is currently uncertain. One of the largest planned projects with projected total investment of over US$ 5.2 billion was halted in March 2008 due to high feedstock prices that made the project unviable (Dillon, Laan, & Dillon, 2008). There are several financial factors that affect the market outlook. Currency devaluation is an issue for companies that have large off-shore dollar loans and costs of imported fertilizers, herbicides and machinery rise as currency devalues. The key input associated with maintaining yields is fertilizer and its outlook is considered further in this section.
A biofuel subsidy
In order to kick-start the industry, the government has proposed a subsidy for biofuels to align its pricing with that of fossil fuel (also subsidized – see Section on Sustainability and Economics). The proposed subsidy would total Rp 1.55 trillion (US$150 million) for 2010 and would represent approximately Rp 2,000/ liter biofuel (approx US$0.2/ liter).

A proposed subsidy for biofuel of Rp2,000/ liter (US$0.2/ liter) is not only expected to increase the cost-competitiveness of biofuels but is expected to deliver additional benefits for the government in the form of tax revenues. By increasing the use of CPO for biodiesel domestically, it is expected that the price will remain relatively high and CPO price volatility will be reduced. As shown in Table 4, the progressive rate of export duty levied results in GoI tax receipts increasing substantially as the price of CPO increases above $550/t. Whether the Government raises enough duty from exporting CPO to cover cost of the subsidy depends on how much more is exported and the CPO price. In 2007, palm oil production was around 16.9Mt and 11.9Mt was exported. Since a tonne of CPO produces about 850 liters biodiesel, the biofuel subsidy costs about $170/t CPO. If the export price were US$850/t, the tax revenue from Table 4 of $1 billion would subsidize 5 billion liters of biodiesel (6MT of CPO) which is equivalent to a blend of 20% biodiesel based on 2007 fossil diesel demand. This quantity also matches the domestic biodiesel use target for 2025.

Table 4: Government tax revenue implications of price rises for CPO

<table>
<thead>
<tr>
<th>CPO price ($/t)</th>
<th>Export tax (%)</th>
<th>Export tax ($ / t)</th>
<th>Volume exported (t)</th>
<th>Tax revenue ($)</th>
<th>$100 increase in price - tax revenue increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>550</td>
<td>2.5%</td>
<td>14</td>
<td>11,870,000</td>
<td>163,212,500</td>
<td></td>
</tr>
<tr>
<td>650</td>
<td>5.0%</td>
<td>33</td>
<td>11,870,000</td>
<td>385,775,000</td>
<td>222,562,500</td>
</tr>
<tr>
<td>750</td>
<td>7.5%</td>
<td>56</td>
<td>11,870,000</td>
<td>667,687,500</td>
<td>281,912,500</td>
</tr>
<tr>
<td>850</td>
<td>10.0%</td>
<td>85</td>
<td>11,870,000</td>
<td>1,008,950,000</td>
<td>341,262,500</td>
</tr>
<tr>
<td>1,110</td>
<td>10.0%</td>
<td>111</td>
<td>11,870,000</td>
<td>1,317,570,000</td>
<td></td>
</tr>
</tbody>
</table>

Source: Based on export tax data from IPOB, 2008

Key players
State-owned enterprises are key players in most sectors of Indonesia’s economy (though some now have private investment). The following are some of the most relevant state-owned enterprises for the biofuel industry:

- PLN (PT Perusahaan Listrik Negara: state electricity company) is Indonesia’s state-owned power utility and distributes electricity to more than 33.3m residential, commercial and

---

7 The government estimates that the country would need 214,541 kiloliters of bioethanol for Premium gasoline and 562,534 kiloliters of biodiesel for subsidized diesel fuel. The subsidy of Rp 2000/ liter would mean Rp 429.08 billion in subsidies for bioethanol and Rp 1.125 trillion in subsidies for biodiesel.
industrial customers. It has monopoly control over electric power generation and has been designated as “standby” consumer of any excess fuel-grade straight vegetable oil at market price (Dillon, Laan, & Dillon, 2008).

- Pertamina (Perusahaan Tambang Minyak Negara: state oil company) is now a Limited Liability Company with a vertically integrated system covering upstream and downstream activities. Its main objective is to meet the domestic market fuel demand as well as non-fuel and petrochemical demand in the domestic and international markets. Pertamina is under a mandate from the government to provide transport fuel and kerosene at subsidized prices. It is also required to provide blended biofuels at the same price as subsidized petroleum fuels. Until 2001, Pertamina was both a regulator and service provider in the petroleum sector. It is also a designated as “standby” consumers of any excess bioethanol and biodiesel production (Dillon, Laan, & Dillon, 2008).

- PTPN (the National Plantation Company). There are 14 state-owned enterprises that operate in the plantation industry. The PTPNs are leading domestic producers of CPO and sugarcane. Despite this, smallholders and private estates produce the majority of CPO (see Figure 19).

5.1 Relevance and drivers of sustainability standards

The Indonesian government is focusing attention on a number of feedstocks for the development of biofuels. It is likely that the majority of biofuel as an end product will be consumed domestically, whereas key feedstocks such as palm oil will be used for biofuel production on the international market.

- Palm oil

Indonesia is now the largest CPO exporter in the world (having overtaken Malaysia). India, China, the Netherlands, as well as the EU as a whole, are substantial importers. In 2007, Indonesia exported approximately 11.9 million tons of CPO with a value of US$7.9 million (IPOB, 2008). Internationally, it is estimated that around 5% of CPO is used for biofuel production. Applying this statistic to Indonesia would mean that 0.6MT of CPO may be impacted by global biofuel sustainability standards which would represent a value of around US$0.4m. Assuming an average of 2.85tCPO/ha, the 0.6MT would represent around 211,000ha.

However, the potential CPO equivalent of all EU biodiesel imports in 2020 could be 3.32Mt based on EU calculations. If 50% this was sourced from Indonesia, it would

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8 See Figure 3-1 in http://www.renewablefuelsagency.org/_db/_documents/Ecofys_Review_of_EUIA_on_biofuel_targets.pdf
Assumes all imports met by palm biodiesel. 0.95tonnes biodiesel per tonne palm olein and 0.8tonnes palm olein per tonne CPO.
represent 14% of the 2007 export volume and would translate to an impact on 0.6Mha, approximately 9% of the 6.32Mha reported in 2007 (IPOB, 2008).

- Sugarcane
  Indonesia used to be the second largest sugarcane producer in the world, but it has now become the second largest sugar importer. Not only have hectares of sugarcane crops decreased on average by around 90,000ha/yr from 1995-2007, but yield has also decreased down from around 77 t/ha in the 1990s to around 63 tons in the 2000s. Government policy is primarily focused on sugar self-sufficiency, and sugarcane for domestic bioethanol production is not expected to be a feedstock that is impacted by any global biofuel sustainability standards that are based on market-demand (through trading) unless the standard commands a premium price domestically.

- Cassava (for ethanol) and jatropha (for straight vegetable oil and biodiesel are also planned biofuel feedstocks for the domestic market. Market-demand will be unlikely to deliver a driver for developing and applying sustainability standards unless the product commands a premium price domestically or an external incentive is applied.

### 6.0 IMPLICATIONS OF EXCLUSION CRITERIA ON PRODUCTION PLANS

The land area of Indonesia is around 181Mha and approximately 48.5Mha is reported to be agricultural land (FAOstats). However, reported statistics vary (explained in Box 4) for several reasons, including that land may be administratively classified as forest but in reality has been logged and is no longer a forest in the land-cover sense of the word or because the land is simply within the Ministry of Forestry’s jurisdiction.

In 2007, 1.4Mha was indicated for oil palm expansion by 2010 (IPOB, 2007). However, based on data compiled in 2005, the total oil palm expansion figure for 2020 was almost 20Mha (Colchester, et al., 2006), which would provide for end uses in the food and pharmaceutical industries rather than biofuel only. Published estimates for oil palm specifically to meet domestic biofuel demand are 4Mha in 2015 (Bahan Bakar Nabati, 2006). In 2007, 5.1Mha of available or unutilized land was reported to be available for oil palm production (IPOB, 2007). This comprised 3Mha of unutilized HGU land and 2.1Mha of inactive permits issued by local governments.

There are a number of emerging biofuel sustainability standards that may impact the developing industry in Indonesia. The following section explores policy, plans, and sustainability standards related to biofuels and their potential impact for Indonesia.

The Special Biofuel Zone (SBZ) is a concept created for the biofuel development program in Indonesia. Certain areas throughout the archipelago, which are sized at least 10,000 ha in Java or
100,000 ha outside Java, will be designated as SBZs based on evaluations to gauge their potential for development as well as their observance of a set criteria. The criteria are intended to ensure that zones have met necessary standards for infrastructure, including transportation and labor requirements needed for effective biofuel production. The SBZ classification is intended to be for industrial, cultivation and non-cultivation conservation zones and to streamline the process of investing in biofuel by acting as a single body for issuing of licensing and permits for investors.

Table 5: Overview of the planned locations for Special Biofuel Zones

<table>
<thead>
<tr>
<th>No</th>
<th>Location</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pacitan – Wonogiri – Wonosari /Pawonsari – (Central Java)</td>
<td>Cassava</td>
</tr>
<tr>
<td>2</td>
<td>Garut – Cianjur – Sukabumi Selatan – (West Java)</td>
<td>Cassava</td>
</tr>
<tr>
<td>3</td>
<td>Lebak – Pandeglang – (Banten)</td>
<td>Jatropha</td>
</tr>
<tr>
<td>4</td>
<td>Lampung, South Sumatera and Jambi</td>
<td>Cassava, Sugar Cane, Jatropha and Palm Oil</td>
</tr>
<tr>
<td>5</td>
<td>Riau</td>
<td>Palm Oil</td>
</tr>
<tr>
<td>6</td>
<td>Aceh (N A D)</td>
<td>Cassava, Sugar Cane and Jatropha</td>
</tr>
<tr>
<td>7</td>
<td>East Kalimantan</td>
<td>Jatropha and Palm Oil</td>
</tr>
<tr>
<td>8</td>
<td>South Sulawesi, South East Sulawesi, Central Sulawesi and Gorontalo</td>
<td>Cassava, Sugar Cane, Jatropha and Palm Oil</td>
</tr>
<tr>
<td>9</td>
<td>West Nusa Tenggara (NTB) and East Nusa Tenggara (NTT)</td>
<td>Cassava and Jatropha</td>
</tr>
<tr>
<td>10</td>
<td>North Maluku</td>
<td>Sugar Cane and Jatropha</td>
</tr>
<tr>
<td>11</td>
<td>North Papua and West Irian</td>
<td>Palm Oil</td>
</tr>
<tr>
<td>12</td>
<td>Merauke – Mappi – Boven Digul – Tanah Merah (Papua)</td>
<td>Cassava, Sugar Cane, Jatropha and Palm Oil</td>
</tr>
</tbody>
</table>

Source: BPPT
Note: Current status of the locations still under planning. One biofuel zone in Gorontalo has been approved

The focus of the Indonesian Government at the present time, with regard to sugar is increasing the productivity of sugarcane in order to become self-sufficient in sugar. Despite this focus on sugar, large potential exists for sugarcane to produce bioethanol in Indonesia and within national plans around 1.75Mha is forecast for use to supply feedstock for domestic biofuel purposes (Bahan Bakar Nabati, 2006).

Sugarcane

**Figure 6: ‘Geophysical plus’ potential for sugarcane in Indonesia**

Table 6 illustrates that by applying high level sustainability criteria to determine the ‘geophysical plus’ potential in Sugarcane Figure 6 reduces the potentially suitable land for sugarcane by 39.6Mha or 69%.

The provinces with over 1Mha of land considered to be in the ‘geophysical plus’ category are East Java, South Kalimantan, East Kalimantan, South Sulawesi and North Sumatera. According to Table 5, sugarcane is not identified as a potential focus within a Special Biofuel Zone (SBZ) within East Kalimantan despite its potential. Sugarcane is identified within the SBZ for Papua, and it does have relatively good potential there, according to the analysis. However, the lack of infrastructure, illustrated in Sugarcane Figure 6, will be a substantial economic obstacle for this development.
Competition for land in some of these provinces is likely to mean that the real potential is substantially lower than indicated above. For instance, in East Java the intensity of land use is already high and sugarcane is one of the many crops already cultivated (Java accounts for the majority of sugarcane production in Indonesia). Rice paddy accounts for approximately 1.7Mha while the ‘geophysical plus’ potential for sugarcane accounts for 1.6Mha. Despite this apparent conflict, there is potential to develop currently underutilized land, such as upland areas that also play a key role in critical watershed management.

Table 6: Summary of results from the national scale GIS analysis for sugarcane

<table>
<thead>
<tr>
<th>Category</th>
<th>Hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Geophysical potential for sugarcane</td>
</tr>
<tr>
<td>B</td>
<td>Geophysical potential excl peatland and forested area</td>
</tr>
<tr>
<td>C</td>
<td>Geophysical potential excl peat, forest &amp; protected areas</td>
</tr>
<tr>
<td>D</td>
<td>Geophysical potential excl peat, forest, PA's &amp; high water &amp; soil erosion ('Geophysical plus')</td>
</tr>
<tr>
<td>E</td>
<td>Current sugarcane area</td>
</tr>
<tr>
<td><strong>Additional potential for sugarcane (D minus E)</strong>(^1), assuming all sugarcane is currently grown in area D(^2)</td>
<td><strong>17,066,367</strong></td>
</tr>
</tbody>
</table>

\(^1\) Existing uses of land for other crops or as hunting grounds are not accounted for therefore this is an optimistic scenario.

\(^2\) Not all sugarcane cultivation will take place within category D but this high level assumption is used to ensure only additional potential is counted.

Some potential sugarcane land is on rice paddies. The national total of rice paddy is 12,147,637ha. Removing this entire area from the ‘geophysical plus’ category and existing sugarcane production results in an available area of 4,918,730ha which could produce approximately 27.5 billion liters of bioethanol (around 20 billion liters based on equivalent gasoline energy content). This amount of bioethanol still surpasses current gasoline demand of 18.7 billion liters. At an E15 blend (national 2025 goal) this would require 2.8 billion liters (on a volumetric basis) and potentially therefore allow an export of 24.6 billion liters. Higher yields of cane at 80t/ha.yr on the additional potential area would produce approximately 34 billion liters of bioethanol per year.

**Oil Palm**

The European Parliament has legislated that biofuel feedstocks must not come from continuously forested land, wetlands or areas of high biodiversity. In addition, other sustainability standards address issues such as avoiding soil and water erosion.
It is usually suggested that around 5% of global CPO production is currently used for biodiesel production. Sustainability standards for biofuel could therefore represent around 600,000t of CPO from Indonesia. If EU forecasts of import requirements are met only by Indonesian CPO, there would be an additional requirement for 3.32MT\textsuperscript{10}, which could substantially affect the CPO export market.

The following analyses are conducted on a national scale and serve as an illustration of the implications of such sustainability standards on the potential and planned feedstock activities for biofuel.

Table 7 illustrates that by applying high level sustainability criteria to determine the ‘geophysical plus’ potential, shown in Figure 7, the amount of potentially suitable land for oil palm is reduced by 67.5Mha or 73%.

Figure 7: Geophysical ‘plus’ potential of oil palm in Indonesia

\textsuperscript{10} See Figure 3-1 in http://www.renewablefuelsagency.org/_db/_documents/Ecofys_Review_of_EUIA_on_biofuel_targets.pdf. This calculation assumes all imports met by palm biodiesel. 0.95tonnes biodiesel per tonne palm olein and 0.8tonnes palm olein per tonne CPO.
**Table 7: Summary of results from the national scale GIS analysis for oil palm**

<table>
<thead>
<tr>
<th>Category</th>
<th>Hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>A  Geophysical potential for oil palm</td>
<td>92,366,422</td>
</tr>
<tr>
<td>B  Geophysical potential excl peatland and forested</td>
<td>45,856,913</td>
</tr>
<tr>
<td>C  Geophysical potential excl peat, forest &amp; protected areas</td>
<td>44,944,027</td>
</tr>
<tr>
<td>D  Geophysical potential excl peat, forest, PA's &amp; high water &amp; soil erosion (Geophysical 'plus')</td>
<td>24,885,620</td>
</tr>
<tr>
<td>E  Current oil palm area</td>
<td>6,324,324</td>
</tr>
<tr>
<td>**Additional potential for oil palm (D minus E)**¹, assuming all oil palm is currently grown in area D²</td>
<td><strong>18,561,296</strong></td>
</tr>
</tbody>
</table>

¹ Existing uses of land for other crops or as hunting grounds are not accounted for therefore this is an optimistic scenario.
² Not all oil palm cultivation will take place within category D but this high level assumption is used to ensure only additional potential is counted.

Based on this remaining ‘geophysical plus’ potential in each region of the country, the average productivity for each region published by IPOB (2008) and an assumption of 854 liters biodiesel/t CPO, the potential ‘geophysical plus’ area could produce around 53 billion liters of biodiesel. Given that some of this land is already in cultivation the additional production of 18.6Mha would represent around 38.4 billion liters of biodiesel. This compares to a fossil diesel demand of approximately 26 billion liters. At a blend of 20% biodiesel (the domestic goal for 2025) the domestic requirement of around 5 billion liters would mean the biodiesel available for export would be in the region of 33 billion liters. With increased yields to 4tCPO.ha, the additional biodiesel production could potentially be 63 billion liters. These calculations assume the palm oil is used only for biodiesel production and therefore the real potential would be lower.

**Implications for potential expansion plans**

Figure 8 illustrates that many of the provinces will not be able to achieve planned expansion within the limitations of the sustainability criteria used in this analysis. The three provinces with the greatest differential between planned expansion and area under the ‘geophysical plus’ category are Papua, Kalimantan Barat and Bangka Belitung.
Figure 8: Planned expansion area of oil palm through 2020 and ‘geophysical plus’ potential area (ha)

Source: Colchester, et al., 2006 for the planned expansion data

Figure 9 illustrates that parts of existing oil palm concessions are located on areas that are not classed as ‘geophysical plus’ potential and therefore could be deemed potentially ‘unsustainable’ by sustainability criteria established in the EU biofuels directive. However, other areas within the concessions appear uninhibited by such criteria. In the main oil palm growing regions, the areas within current concessions that are classified under the ‘geophysical plus’ potential are Jambi – 292,760 ha, Riau – 337,595 ha, Kalimantan – 1,137,860 ha. Clearly there are substantial areas that are classified as geophysical ‘plus’ potential but are not within existing concessions. However, key data limitations on land rights or about highly biodiverse areas (other than protected areas) limit the robustness with which such conclusions around sustainability can be made.
Outcome of GIS analysis for oil palm and sugarcane

Table 8 illustrates an optimistic scenario for land availability with ‘geophysical plus’ potential that is not forested, on peatland or protected areas and has low risk of erosion. This is the result of a desk-based GIS analysis and does not exclude lands with customary titles that may therefore have issues associated with its use that could infringe ‘land rights’ criteria of standards such as the RSPO and RSB. However, the previous analysis serves to illustrate the substantial potential for Indonesia to address its domestic fossil fuel domestic demands with biofuel while still permitting significant exports, even with a relatively small percentage of the land that is geophysically capable of producing feedstocks.
Table 8: Results of potential biofuel production on the geophysical ‘plus’ category and the demand for fossil fuel.

<table>
<thead>
<tr>
<th></th>
<th>Potential biodiesel production from oil palm (million liters)</th>
<th>Potential ethanol from sugarcane (million liters)</th>
<th>Diesel (Solar) consumption (million liters)</th>
<th>Gasoline consumption (million liters)</th>
<th>Kerosene consumption (million liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area I</td>
<td>3,055</td>
<td>3,405</td>
<td>1,882</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area II</td>
<td>6,006</td>
<td>10,902</td>
<td>6,300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area III</td>
<td>1,760</td>
<td>2,366</td>
<td>1,461</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area IV</td>
<td>189</td>
<td>327</td>
<td>257</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Total transportation</td>
<td>-</td>
<td>11,010</td>
<td>17,000</td>
<td>9,900</td>
<td></td>
</tr>
<tr>
<td>Other (industry use)</td>
<td>-</td>
<td>15,000</td>
<td>35</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>38,835</td>
<td>95,401</td>
<td>26,010</td>
<td>17,035</td>
<td>9,996</td>
</tr>
</tbody>
</table>

Note: Areas are defined by Pertamina. Area I largely covers Sumatra, Area II largely covers Java (and therefore includes Jakarta), Area III largely covers Kalimantan, Sulawesi and Papua and Area IV covers a much smaller area that includes Nusa Tenggara.

Source: Fossil fuel data from Pertamina and biofuel data are calculated from GIS analysis results.

### 7.0 SUSTAINABILITY ISSUES & INSTITUTIONAL CAPACITY

The following sections explore the issues identified by sustainability standards and explore their relevance and status in Indonesia.

#### 7.1 Legislation & Governance

The legislative framework in Indonesia will influence the capacity to address sustainability issues for biofuels. It is widely acknowledged that there are substantial limitations to the effectiveness of enforcement in Indonesia. There is disharmony among laws and regulations that contributes to the difficulty of delivering on the aims of environmental legislation. Roles and responsibilities are often conflicted for example, while the Ministry of Environment would be a key institution for delivering environmental priorities, the Ministry of Forestry is the implementing agency for the Law on Conservation of Biodiversity and Ecosystems (1990) and for administration and management of 68% of the land area of Indonesia (Rhee et al, 2004). Another area of inconsistency is language. Even within the basic laws dealing with conservation, different terms are used to refer to protected areas. This impedes clear implementation of policy (Rhee et al, 2004).
Table 9: Overview of environmental legislation in Indonesia relevant to biofuel sustainability

<table>
<thead>
<tr>
<th>Law</th>
<th>Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Law 5/1990. Conservation of Biodiversity and Ecosystems.</td>
<td>Law regulates understanding of the protection of life support systems, conservation of biodiversity, sustainable use of biological resources and ecosystems, nature conservation areas, use vegetation and wildlife, role of the community, and activities related to assistance, investigations, and criminal stipulations</td>
</tr>
<tr>
<td>Law 41/2000. Basic Forestry Law</td>
<td>Defines main forest functions and the need for planning. Includes provisions on participatory forestry planning, people’s economic empowerment, transfer of partial authority to regional governments, and community-based forest monitoring</td>
</tr>
<tr>
<td>Law 23/1997. Management of the Environment.</td>
<td>States that natural resources are controlled by the State to maximize the prosperity of the community. Provides that the government will (1) regulate and develop policy for environmental management; (2) regulate the availability, allocation, use, management, and returns from natural resources; (3) regulate the creation of Law and the relationship between people and the Law; (4) mitigate activities that have environmental and social impacts; and (5) develop funds for initiatives to conserve the function of the environment.</td>
</tr>
<tr>
<td>Law 24/1992. Spatial Use Management.</td>
<td>Seeks to implement the arrangement of protected areas and cultivation areas and achieve spatial organization with a certain quality</td>
</tr>
<tr>
<td>MPR Decree No. IX/2001 on Agrarian Reform and Natural Resources Management</td>
<td>This decree provides a mandate to the DPR and President of Indonesia to implement policies on agrarian reform and the management of natural resources according to the principles of sustainable development, national integrity, human rights, legal supremacy, justice, democracy, participation and people welfare, taking into consideration the social, economic and cultural conditions of the community and the ecological functions of natural resources</td>
</tr>
<tr>
<td>Decree on oil palm on peatland: 14/Permentan/PL.110/2/2009</td>
<td>States that ‘due to the lack of [mineral soil] [oil palm planting] can be done on peatland as long as it is done in accordance with the sustainability of peatland functions: (a) carried out only on community land cultivation land, (b) on peatland that has depth less than 3 meters, (c) the subsoil under the peatland is not silica sand or acid sulfate soil; (d) the maturity of the soil is sapric (the most decomposed) or hemic (somewhat decomposed); and (e) eutropic peatlands’</td>
</tr>
</tbody>
</table>


Legislation to address environmental impacts at the site specific scale exists. In order to receive a permit (IUP) for plantation crop development\(^{11}\), an approval letter for the environmental impact assessment (AMDAL) from the local commission of AMDAL is required. However, the number of permissions required in the application process is substantial: amongst other details, required applicants must have a) recommendation of plantation location from Land Agency (BPN) b) technical consideration of the land availability from forestry institution (for land classified as forest area c) technical consideration of the land availability from Head of Provincial Estate Crop Services based on the spatial plan. Annex 2 details the complexity of the IUP process. It is possible that the focus for plantation development is on administrative compliance given the risks and timescale involved, rather than a focus on delivering sustainable outcomes (Rhee et al, 2004) through the EIA process.

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\(^{11}\) Based on Decree No.256/Permentan/OT.140/2/2007 from the Ministry of Agriculture.
Labour legislation

Child labor is regulated under the manpower law (no.13 year 2003) and the law on child protection (no. 23 year 2002). Anyone under 18 years old is considered a child and is not allowed to work. However, the implementing regulation refers to employment in the formal sector and particularly refers to types of work that would “block the child’s access to education”. This clause is included in response to the fact that many children help their parents with their small-scale business in the informal sector, e.g. pushcart vendors, home manufacturers, etc. The enforcing ministry is the Ministry of Manpower (Departemen Ketenagakerjaan), where arbitrators and civilian investigators provide support for potential cases of violations. However, no child labor case has been formally acted upon. Indonesia has a separate ministry for women’s empowerment, which coordinates children protection policies. However, ministry for women’s empowerment is generally regarded as inept as it has not been equipped with enforcing power and ministerial appointments are largely political ones.

Poor coordination between the actors involved in biofuel promotion and conflicting objectives may also present a challenge for delivering a sustainable biofuel strategy. Table 10 illustrates the roles and responsibilities of institutions related to biofuel promotion, as defined in Presidential Memorandum No 1. There are a substantial number of actors involved at the national and local levels (see following section for governance issues). Some issues addressed by sustainability standards do not appear to be covered by the Memorandum. Water issues, for example, have not been addressed. While the Ministry of Health is responsible for water quality-related aspects, and to a certain extent rural services, responsibility for the urban sector is shared between the Ministry of Home Affairs and the Ministry of Public Works. KIMPRASWIL (Ministry of Human Settlements and Regional Infrastructure), acting through district and sub-district offices of the Water Resources Service (Dinas Pengairan), is responsible for the construction and maintenance of primary and secondary irrigation canals. Furthermore, the Ministry of Manpower, as the enforcing ministry of the law on child protection, is not involved in the Decree.

Table 10: Roles and responsibilities of institutions related to biofuel promotion defined in Presidential Memorandum No 1.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinating Minister for the Economy</td>
<td>Co-ordinates preparation &amp; execution of supply and utilization of biofuel.</td>
</tr>
<tr>
<td>Department of Energy and Mineral Resources</td>
<td>Executes policy of supply and exploitation of biofuels.</td>
</tr>
<tr>
<td></td>
<td>settles policy of incentives and tariffs for development of supply and exploiting of biofuels by co-coordinating with related institutions.</td>
</tr>
<tr>
<td></td>
<td>Defines the standard and quality of vegetable fuel (biofuel).</td>
</tr>
<tr>
<td></td>
<td>Defines system and procedure for quality testing of vegetable fuel (biofuel).</td>
</tr>
<tr>
<td></td>
<td>Encourages companies to be active in energy and mineral resources to exploit biofuel.</td>
</tr>
<tr>
<td>Department of Agriculture</td>
<td>Promotes supply of raw material, including seed.</td>
</tr>
<tr>
<td></td>
<td>Facilitates supply of raw material.</td>
</tr>
<tr>
<td></td>
<td>Integrates activity of development and activity of post crop and raw material production.</td>
</tr>
</tbody>
</table>
### Institution | Role
--- | ---
Department of Forestry | - Issues permits from exploitation of non-productive forest land for development of biofuel raw material pursuant to law and regulation.
Department of Industry | - Increases development expansion of domestic equipment for processing of vegetable fuel raw material and encourage entrepreneurs in developing biofuel industry.
Department of Trade | - Facilitates availability of supply of biofuel and raw material.  
  - Guarantees availability of supply and distribution equipment for processing and exploiting biofuel.
Department of Communication | - Facilitates improvement of exploitation of biofuel in transportation sector.
State Minister for Research & Technology | - Develops technology and recommends applications for exploitation of supply technology and processing, raw material distribution and utilization of biofuel.
State Minister for cooperatives & small and medium enterprise | - Promotes cooperation within small and medium sized industry to participate in development of raw material and processing and trading of biofuel.
State Minister for state owned enterprises | - Promotes government-owned corporations of agriculture, plantation and forestry to develop crop vegetable fuel raw material (biofuel).  
  - Promotes government-owned corporations to develop industry processing of vegetable fuel (biofuel).  
  - Promotes government-owned engineering corporations to develop technological processing of vegetable fuel (biofuel).  
  - Promotes government-owned energy corporations to exploit vegetable fuel (biofuel).
Department of Home Affairs | - Coordinates and facilitates local government lines and preparation of public in supply of land in each area, especially land critical for raw material.
Ministry of Finance | - Studies regulation of laws in finance-related issues to provide incentive and priority of fiscal measures for supply of raw material and biofuel.
State Minister for Population | - Performs socialization and communications to the public about exploiting vegetable fuel (biofuel) as an environmentally friendly fuel.
Provincial Governor (Province level) | - Executes policy to increase exploitation of biofuel in its area as according to its authority.  
  - Executes socialization of exploitation of biofuel in its area.  
  - Facilitates supply of land in its area with its authority, especially critical land for clean energy from vegetable fuel raw material (biofuel).  
  - Reports execution of this instruction to The Minister of Home Affairs.
Regent / Major (Bupati) (District level) | - Executes policy to increase exploitation of biofuel in its area as according to its authority.  
  - Executes socialization of exploitation of biofuel in its area.  
  - Facilitates supply of land in its area appropriate with its authority, especially critical area for clean energy with appropriate vegetable fuel raw material (biofuel).  
  - Reports execution of this instruction to Governor.

### Governance
The country is divided into 30 provinces and 315 districts (Kabupaten) and municipalities (Kota). Each of these entities has their own elected legislative Assemblies. Thus, there is a three-tier government
and public administration system comprising the national, provincial, and district/municipalities or local levels.

**Box 2: Decentralization and implications for biofuels**

Decentralization laws passed between 1998 and 2002, mean that local governments have gained greater control over lands, forests, budgets and planning.

A new law allows district level regents (bupati) to issue permits of up to 1,000 hectares for agricultural use, while any areas overlapping district boundaries remain the prerogative of Provincial Governors. However, authority to issue permits of over 1000 hectares was entrusted to the Ministry of Agriculture (Colchester, et al., 2006). For biofuel plants, those less than (or equal to) 10,000mt permits are issued at the Provincial Level and for greater than 10,000mt are issued by the Ministry for Oil and Gas.

Local governments develop spatial plans that determine their plans for land allocation and land use. These plans differ from those developed at the national scale and establish a perpetual process of alignment. National spatial plans almost always differ from local (provincial) spatial plans.

In the longer term decentralization is intended to bring greater transparency to land acquisition and benefit sharing processes. In the short term it has created or exacerbated gaps in coordination between the various line ministries, making both compliance and monitoring more challenging and potentially introducing new opportunities for rent-seeking.

### 7.2 Economic issues and institutional capacity

The economic sustainability of biofuels is a key part of meeting energy security and socio-economic goals in Indonesia. Prices of fossil fuels in Indonesia are listed in Table 11. Fossil fuels under the Public Service Obligation (PSO) receive direct Government subsidies and result in the lower prices identified in Table 11. Biofuels do not receive a comparable subsidy\(^{12}\) and are, for the most part, uncompetitive with the subsidized fuel.

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\(^{12}\) This does not include subsidies for the feedstock itself.
Table 11: Fossil fuel prices in Indonesia (2000-2007)

<table>
<thead>
<tr>
<th></th>
<th>Gasoline (Rp/l)</th>
<th>Kerosene (Rp/l)</th>
<th>Automotive Diesel Oil (ADO) (Rp/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>1150</td>
<td>350</td>
<td>600</td>
</tr>
<tr>
<td>2001</td>
<td>1150-2180</td>
<td>400-2560</td>
<td>900-2570</td>
</tr>
<tr>
<td>2002</td>
<td>1450-1750</td>
<td>820-2220</td>
<td>900-2120</td>
</tr>
<tr>
<td>2003</td>
<td>1810-2100</td>
<td>1800-2200</td>
<td>1650-2100</td>
</tr>
<tr>
<td>2004</td>
<td>1810-2100</td>
<td>1800-2200</td>
<td>1650-2100</td>
</tr>
<tr>
<td>2005</td>
<td>1810-6290</td>
<td>1800-6480</td>
<td>1650-6170</td>
</tr>
<tr>
<td>2006</td>
<td>4500-6785</td>
<td>2000-6786</td>
<td>4300-6863</td>
</tr>
<tr>
<td>2007</td>
<td>4500-6681</td>
<td>2000-7159</td>
<td>4300-8286</td>
</tr>
</tbody>
</table>

Notes: * For ease of calculation approximation US$1 = 10,000Rp
Source: Indoneisian Institute for Energy Economics, 2007

The following sections explore the drivers of economic sustainability for biofuels and address the extent to which current conclusions may be altered through direct intervention (e.g. in investment in yield increases or subsidies) and changes in market situations (e.g. feedstock prices).

Bioethanol production costs

Sugarcane-based bioethanol cost of production is heavily influenced by feedstock costs. For every $5 increase in the price of sugarcane the biofuel production cost increases by around $0.06/ litre (Table 12).

Assumptions

- Feedstock cost is delivered cost
- Small to medium scale processing cost is US$0.14/l
- Yield is 86 liters/ t cane
- Transport of biofuel is excluded
- Subsidy is IDR 2000/l (US$0.2/l)
- 1 barrel oil equivalent is 6100MJ (HHV)
- 1 liter ethanol is 23.9 (HHV)
- 1 liter biodiesel is 32.0 (HHV)
- 159 liters per barrel (volumetric)
- $/bbl does not include refinery uplift price
Table 12: Sugarcane bioethanol production costs (small-med scale) without subsidy and comparison with gasoline.

<table>
<thead>
<tr>
<th>Feedstock cost ($/t) Sugarcane</th>
<th>Biofuel production cost ($/l) without subsidy$^1$</th>
<th>Breakeven gasoline for 1 liter at equal energy to ethanol ($/l$)$^2$</th>
<th>Subsidized 2007 gasoline price as % of breakeven gasoline price$^3$</th>
<th>Unsubsidized 2007 gasoline price as % of breakeven gasoline price$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>0.31</td>
<td>0.43</td>
<td>104%</td>
<td>155%</td>
</tr>
<tr>
<td>20</td>
<td>0.37</td>
<td>0.51</td>
<td>88%</td>
<td>131%</td>
</tr>
<tr>
<td>25</td>
<td>0.43</td>
<td>0.59</td>
<td>76%</td>
<td>113%</td>
</tr>
<tr>
<td>30</td>
<td>0.49</td>
<td>0.67</td>
<td>67%</td>
<td>100%</td>
</tr>
<tr>
<td>35</td>
<td>0.55</td>
<td>0.75</td>
<td>60%</td>
<td>89%</td>
</tr>
<tr>
<td>40</td>
<td>0.61</td>
<td>0.83</td>
<td>54%</td>
<td>80%</td>
</tr>
</tbody>
</table>

$^1$ Biofuel production cost does not account for the potential benefits of additional sources of revenue e.g. from electricity export sales

$^2$ This is the price of gasoline per liter where 2/3 liter (same energy as a liter of ethanol) costs same as 1 liter of ethanol

$^3$ Based on prices of US$0.45/l (subsidised) and US$0.67/l (unsubsidised) from Table 11

Table 12 indicates that when cane feedstock prices are at US$25/t, which equates to a bioethanol production cost of $0.43/l, gasoline at equal to or less than US$0.59/l would compete on an equivalent energy basis. At this cost of cane, ethanol is less expensive on an equal energy basis (unsubsidized gasoline is 113% of the breakeven cost against ethanol). However, if gasoline is subsidized it is less expensive than ethanol on an equivalent energy basis (at 76% of the breakeven price). Absent subsidies for gasoline, ethanol would be competitive when cane costs less than $30/t. The presence of a subsidy for gasoline reduces the breakeven cost of cane to $16/t. Since transport costs are not included the breakeven estimates do not reflect the variation due to this cost.

Another issue that impacts use of sugarcane to produce ethanol is the comparative prices for ethanol and raw sugar. Sources indicate that sugarcane ethanol could be attractive compared to sugar production in some cases. The opportunity costs i.e. selling cane for sugar would vary according to the price of sugar and yields of cane but based on anecdotal information opportunity costs for sugar production would require feedstock cost to range from US$23/t cane to US$36/t cane to be more attractive for biofuel production (without accounting for co-product revenues or fuel subsidies).

Figure 10 focuses on the competitiveness of gasoline with an IDR 2000/l subsidy for biofuel. It illustrates that the equivalence price for gasoline hits US$70/bbl when feedstock costs are around US$15/t without the subsidy and US$33/t with a biofuel subsidy. The subsidy makes ethanol attractive compared to gasoline at relatively high gasoline costs e.g. US$100/bbl.
Figure 10: Equivalence gasoline prices for ethanol ($/bbl) with and without a subsidy for ethanol

Feedstock costs are a significant driver for the cost competitiveness of biofuels. Figure 11 illustrates that yield is the single biggest influencing factor on costs of production and economic competitiveness requires yield increases. Maintenance and weeding is the second factor but is substantially lower. Fertilizer would be substantially more influential but costs for sugarcane are subsidized by the Government.

Figure 11: Sensitivity of sugarcane cost of production (rainfed)

Source: Based on data from Indonesian Sugar Board, 2009.
Figure 11 does not include the cost of irrigation which could add significantly to costs of production – up to $250/ha (around 12% of total costs). However, if irrigation increases yields, the costs of production per tonne of cane may improve. Even if irrigation increases yields by a modest 10t/ha this improves net returns to around $300/ha which is enough to offset the cost of irrigation and make a small profit.

**Increasing productivity**

Indonesia has a low average yield of sugarcane in comparison to other countries and a low percentage of sugar extraction from the cane. There is no widespread use of high yielding sugarcane varieties. Agronomically and technically, the two most important efforts for increasing the national production of sugarcane are using the high yielding variety and replanting of the old ratoon. Some farmers are using up to 10 ratoons before replanting. This compares to practices in the Philippines where sugarcane is typically ratooned 3- times before replanting. The continual development of new varieties by a national research body as well as increasing yields are important to reduce losses due to disease with older varieties becoming more prone to infection. It is also normal to grow a few different varieties in the same plantation. This helps to reduce risk of losses from conditions that adversely impact one variety but not others. An important factor that influences adoption of new varieties by cane growers and number of ratoons is the cost for new seedcane, fertilizer and price paid for cane. Indonesia is now establishing a national replanting program that will replace the old varieties and ratoon practices with more modern varieties and practices.

Table 13 illustrates some new cane varieties and yields. Variety PSCO 902 is generally recommended for producing bioethanol owing to its 7 months growing season.

**Table 13: Potential of Selected Indonesian Sugarcane Varieties**

<table>
<thead>
<tr>
<th></th>
<th>PS 851 (+/- 12 months)</th>
<th>PS 862 (+/- 12 months)</th>
<th>PS 863 (+/- 12 months)</th>
<th>PSCO 902 (+/- 7 months)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lowland</strong>&lt;br&gt;• Yield (t/ha)</td>
<td>105.0</td>
<td>99.3</td>
<td>129.4</td>
<td>105.5</td>
</tr>
<tr>
<td></td>
<td>9.0</td>
<td>9.5</td>
<td>9.1</td>
<td>11.0</td>
</tr>
<tr>
<td><strong>Upland</strong>&lt;br&gt;• Yield (t/ha)</td>
<td>73.9</td>
<td>88.3</td>
<td>81.1</td>
<td>81.8</td>
</tr>
<tr>
<td></td>
<td>10.7</td>
<td>10.9</td>
<td>11.8</td>
<td>10.3</td>
</tr>
<tr>
<td><strong>Ratoon</strong>&lt;br&gt;• Yield (t/ha)</td>
<td>76.0</td>
<td>92.8</td>
<td>80.4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>11.0</td>
<td>10.8</td>
<td>13.2</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Indonesian Sugarcane Research Institute
**Biodiesel production costs**

Oil-palm based biodiesel costs of production are also heavily influenced by feedstock costs (see Figure 13).

**Assumptions**

- Feedstock cost is delivered cost
- Processing cost is US$0.13/l
- Yield is 854 l biodiesel/t CPO
- Transport of biofuel is excluded
- Subsidy is IDR 2000/l (US$0.2/l)

1 barrel oil equivalent is 6100MJ (HHV)
1 liter ethanol is 23.9 (HHV)
1 liter biodiesel is 32.0 (HHV)
159 liters per barrel (volumetric)

$/bbl does not include refinery uplift price

\[
\text{Assuming production capacity of around 500t/yr. This would drop to 0.055 for a plant of around 120,000t/yr (Widodo & Rahmarestia, 2008).}
\]

**Table 14: Biodiesel production costs and equivalent fossil fuel prices**

<table>
<thead>
<tr>
<th>Feedstock cost ($/t)</th>
<th>Biodiesel production cost without subsidy ($/l)</th>
<th>Diesel cost at equal energy to biodiesel ($/l)(^1)</th>
<th>Subsidized 2007 diesel price as % of breakeven diesel price(^2)</th>
<th>Unsubsidized 2007 diesel price as % of breakeven diesel price(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>350</td>
<td>0.54</td>
<td>0.60</td>
<td>72%</td>
<td>138%</td>
</tr>
<tr>
<td>400</td>
<td>0.60</td>
<td>0.66</td>
<td>65%</td>
<td>125%</td>
</tr>
<tr>
<td>450</td>
<td>0.66</td>
<td>0.73</td>
<td>59%</td>
<td>114%</td>
</tr>
<tr>
<td>500</td>
<td>0.72</td>
<td>0.79</td>
<td>54%</td>
<td>104%</td>
</tr>
<tr>
<td>550</td>
<td>0.77</td>
<td>0.86</td>
<td>50%</td>
<td>97%</td>
</tr>
<tr>
<td>600</td>
<td>0.83</td>
<td>0.92</td>
<td>47%</td>
<td>90%</td>
</tr>
</tbody>
</table>

1 This is the price of diesel per liter when diesel has the equivalent energy content for 1 liter biodiesel
2 Price of US$0.43 (subsidized) and US$0.83/l (unsubsidized) from Table 11

Table 14 indicates that biodiesel cannot compete with 2007 subsidized diesel prices even at feedstock costs of US$350/t. Biodiesel could however compete with unsubsidized diesel prices (2007) up to feedstock costs of around US$525/t. Global palm oil prices rose from US$390 per tonne ($0.33/litre) in November 2006 to over $900 in November 2007 and continued to climb, peaking at $1146 in March 2008 and falling again to $791 in August of the same year (Sheil, et al., 2009). Fossil subsidies and prices for oil palm are therefore a substantial problem for the economic competitiveness of biodiesel in Indonesia.

Figure 12 focuses on the competitiveness of biodiesel with an IDR 2000/l subsidy. It illustrates that without a subsidy for biodiesel the equivalence (breakeven) price for diesel is well over US$70/bbl in the range of realistic feedstock prices. The subsidy for biodiesel is required to make biodiesel competitive.
These production costs do not account for potential co-products which could reduce the breakeven prices against fossil diesel when the glycerine sales revenue is used to reduce the selling price of the associated biodiesel. Since 0.1t glycerin is produced per t biodiesel and glycerin at 99% purity is typically sold for around $600/t (at 80% purity for around $245/t and at 60% purity for around $180/t), the reduction is greatest when high purity glycerin co-product is produced. As an example, when CPO is selling for $400/t the breakeven price for biodiesel against fossil diesel is $106/bbl without sale of glycerin but $90/t when the sale of glycerin is taken into account. The sensitivity analysis in Figure 13 illustrates that the while co-products may help the competitiveness of biodiesel, the main influence on production costs are feedstock costs and biofuel yields.
Figure 14 illustrates that yield is the single most significant driver for oil palm cost of production followed by fertilizer and infrastructure maintenance costs.

**Figure 14: Sensitivity analysis of oil palm cost of production**

Source: Based on data from Agriculture Technology Assessment Institute, 2009

High yielding planting materials, which were developed through a systematic and continuous oil palm breeding program, have increased (but not yet realized) the average potential of oil palm productivity from 4.3t CPO in 1960s to up to 8.1t CPO/ha/year in 2007.

In 2007, IOPRI released two new oil palm varieties and the highest CPO production would be 8.1t CPO/ha/yr (laboratory based testing). The other variety has (fewer bunches) and a higher bunch weight and therefore can reduce harvest workload which may be attractive for smallholders or estates with limited number of workers for harvesting (IOPRI, 2008).

The availability of quality hybrid seeds is essential for establishing plantations and replanting. Among the more than 6m ha existing palm oil plantion in Indonesia up to now, almost 3m ha have been using high yielding varieties from Indonesia Oil Palm Oil Research Institute. The average of CPO yield nationally is only around 2-3 t/ha/year, while the potential yield from new varieties is 7.4-7.9tCPO/ha.yr t/ha (which corresponds to about 30-39 t FFB/ha/year) (IOPRI, 2008).

One of the key inputs associated with maintaining yields for biofuel feedstock and delivering economic viability is fertilizer. Substantial increases in fertilizer production will be required to meet national demand and with risks surrounding the supply of natural gas for production, the risk of increased costs for fertilizer will either negatively impact a) economics of biofuel production or b) Government expenditure (if costs are subsidized).
Fertilizer as a key input

Sustaining current food production and expanding biofuels relies heavily on the availability of fertilizer. Urea is the most common nitrogen-based fertilizer and Indonesia has around 14 domestic urea production facilities with an output of 7.85mt/yr (Budidarmo, 2007). Fertilizer for food crop plantations (such as rice, maize, soybean etc, including sugarcane) are subsidized, while those for estate crops such as oil palm, coffee and cocoa are not. Based on the National Plan, average annual increases in urea demand are around 333,000t, for TSP fertilizer around 8,000t and for KCL fertilizer around 285,000t (Bahan Bakar Nabati, 2006). In 2015, estimates for biofuels alone of 2.8mt of urea (Bahan Bakar Nabati, 2006) are equivalent to the total consumption in of around 3mt of all fertilizer (2002 latest data).

Figure 15: Total fertilizer subsidy costs (Million Rp) and Inset: fertilizer subsidies by fertilizer type.

Source: YBUL, compiled from various sources.

The availability of natural gas (a key urea feedstock) at low enough prices to make production profitable is a risk to a sustainable policy. Other gas consumers, such as PLN, are reportedly able to purchase natural gas at higher costs and therefore potentially reduce the purchasing power and availability of domestic gas for the fertilizer industry. Exports of liquefied natural gas to Singapore,
Japan and South Korea further increase risks that domestic urea production will not meet demand from biofuel expansion projections.

Upward pressure on fertilizer prices has led to the focus on the use of alternative available organic sources. For the palm oil sector, with unsubsidized fertilizer prices, an alternative may be attractive. Fertilizer purchase and application can account for up to 60% of the plantation maintenance costs (IOPRI, 2007). The application of empty fruit bunches (EFBs) alone are not a substitute for fertilizer. It assists in soil conditioning and therefore increases the effectiveness of fertilizer but does not, on its own, reduce the amount of fertilizer than can be applied unless the EFBs are incorporated with Palm Oil Mill Effluent (POME) (IOPRI, pers comm.)

POME can be applied directly to fields as an organic fertilizer after digestion in aerobic ponds (which releases methane) (IOPRI, 2007). However, the site specific topography determines whether such waste management techniques could be used (Musim Mas, pers comm.), and therefore alternatives are needed for uneven topography. New technology under development may influence future developments in this area. A reactor developed by IOPRI (RANUT) reduces land area requirements and reduces retention time and produces around 12m³ of biogas from each m³ POME (IOPRI, pers comm.). The benefits from this combination of biogas production and composting are the energy production, saved POME treatment cost in pond systems, total utilization of the POME nutrients, reduced cost for the EFB transport and utilization, higher Fresh Fruit Bunch (FFB) yields and potential Clean Development Mechanism (CDM) revenues.

**Institutional capacity for biofuel and feedstock production improvements**

**Despite some focus on feedstock productivity relevant to biofuels (Table 15) there is no national biofuel / bioenergy research center in Indonesia.** At present the co-ordination of research is under the scope of the Ministry of Research and Technology. The National Research Council provides advice to the Government and in 2008, found that there were many overlaps of research in the biofuel arena and too much fundamental research is undertaken that is never applied (Soerwejaja, pers comm.). This National Research Council framework offers the opportunity to co-ordinate a national and regional research agenda for biofuels and would require engagement from other Ministries with an interest in biofuels.

**Table 15: Institutional capacity to address productivity improvements**

<table>
<thead>
<tr>
<th>Organization</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEMIGAS (Oil and Gas Technology)</td>
<td>Leading oil &amp; gas research institution. Specializes in technical aspects of biofuels e.g. fuel specifications &amp; testing.</td>
</tr>
<tr>
<td>Indonesian Oil Palm Research Institute (Pusat Penelitian Kelapa Sawit)</td>
<td>Government-owned but self-funded research institute dedicated to R&amp;D in the oil palm industry. Responsible for disseminating knowledge-based products &amp; services (to public &amp; private groups) to support the industry.</td>
</tr>
<tr>
<td>BPPT (Agency for the Assessment and Application of Technology)</td>
<td>R&amp;S institute that specialise in process technology and engineering and are applying this to biofuel production. Operating bioethanol pilot plant facilities</td>
</tr>
<tr>
<td>Organization</td>
<td>Role</td>
</tr>
<tr>
<td>--------------</td>
<td>------</td>
</tr>
<tr>
<td>Bogor Agricultural University (IPB). The Surfactant and Bioenergy Research Center</td>
<td>Research and development on jatropha applications (genetic engineering and plantation technology).</td>
</tr>
<tr>
<td>ITB (Bandung Institute of Technology)</td>
<td>Undertaking research on jatropha applications.</td>
</tr>
<tr>
<td>Indonesian Center for Estate Crops Research and Development (ICERD)</td>
<td>Government-owned and therefore assists Ministry of Agriculture with its obligations toward biofuel development by preparation of seeds and seedlings. Has a focus on jatropha development and cook stove testing program.</td>
</tr>
<tr>
<td>Sugar Research Institute (Pusat Penelitian Perkebunan Gula)</td>
<td>One of the research institutions of Indonesian Planters Association for Research and Development (IPARD) it has a duty to provide various technologies and product innovations for the sugar society improvement for sugarcane farmers and sugar factories (public and private).</td>
</tr>
</tbody>
</table>

### 7.3 Environmental issues & institutional capacity

#### Land use change and Greenhouse Gas (GHG) emissions

The exploitation of natural resources for oil palm development and its potential negative effects are well documented. Indonesia is currently ranked among the top 3 greenhouse gas (GHG) emitters with contributions from deforestation, peatland degradation and forest fires (PEACE, 2007). Contributions from energy use are substantially smaller but are rising rapidly.

Biofuel sustainability issues for oil palm predominantly focus on deforestation. In many parts of the world GHG emissions savings have been a major driver for biofuel policy. In some countries land use changes that produce emissions which negate any GHG savings from the resulting biofuel have resulted in a questionable role for biofuels as part of the solution for reducing transport-related GHG emissions.

Within the land use sector many GHG studies to date have focused on the emissions associated with draining and utilizing peatland for oil palm development. Indonesia is forecast to generate 3,014 Mt CO₂e yr⁻¹ from land use land use change and forestry (LULUCF), which is about six times higher than its emissions from the energy sector only (PEACE, 2007). The Ministry of Agriculture has recently issued a decree on oil palm planting on peatland. It states that ‘due to the lack of [mineral soil], [oil palm planting] can be done on peatland as long as it is done in accordance with the sustainability of peatland functions: (a) carried out only on community cultivation land, (b) on peatland that has depth less than 3 meters, (c) the subsoil under the peatland is not silica sand or acid sulfate soil; (d) the maturity of the soil is sapric (the most decomposed) or hemic (somewhat decomposed); and (e) eutropic peatlands’. The criteria for new plantations within the RSPO standard also establish 3m depth as a limit for planting on peatland. This is the subject of much study. Hooijer, et al. (2006) established the relationship between depth of peat drainage and CO₂ emissions as 0.91 t CO₂ ha⁻¹ yr⁻¹.

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13 Peraturan Menteri Pertanian nomor: 14/Permentan/PL.110/2/2009
per cm of drainage\textsuperscript{14}. The Indonesian Palm Oil Research Institute (IOPRI) currently has a scientific study underway to physically measure emissions from oil palm on peat soil.

Figure 16 illustrates that the geophysical potential for oil palm presents the theoretical risk of significant GHG emissions from land use change based on overlapping area with forest and peatland locations.

\textbf{Figure 16: Geophysical potential for oil palm in land cover categories with high GHG risks following conversion}

Note: From a total of 20.94 million ha of peatland, approximately 2.5\% have already been developed for oil palm plantations.

Figure 17 a and b illustrate that the theoretical risks of Figure 16 are real. Forested areas and peatland areas are within existing concessions for palm oil.

\textsuperscript{14} Note that the data used to develop the equation do not extend beyond about 80 cm, therefore the utility of using the equation to predict CO\textsubscript{2} emissions from drainage beyond this depth are not valid.
Figure 17: a) Peatland areas within existing oil palm concessions in Kalimantan and b) Forested areas within existing oil palm concessions
Institutional capacity for monitoring GHG risks

The National Land Agency (BPN) has an important strategic position in land use planning. BPN is the authoritative body responsible for the national land administration and all other related issues, consisting of land use, land tenure, land rights, and land regulations. BPN also plays an important role in the execution of the spatial planning process on national, provincial, and district levels. BPN is responsible for the issuance of location permits to enterprises for capital investment and monitoring. For the process of spatial planning, BPN contributes to BAPPEDA (regional body for planning and development) with data on present land use and proposals of land allocation plans and legal aspects for land ownership.

The previous sections illustrate GIS techniques used to assess levels of risk associated with sustainability criteria and production areas for biofuel. Monitoring compliance with sustainability standards within Indonesia, including the issued decree, could be substantially improved by the use of such GIS applications. Technical applications of GPS, GIS and remote sensing are increasing in Indonesia but expertise and application has largely been focused on the forestry sector. There is a need to focus capacity building efforts for use within agriculture. Increasingly, GPS and GIS capacity will be sought for Reducing Emissions from Deforestation and Degradation (REDD) applications and opportunities exist to address REDD and biofuel sustainability objectives through such capacity building. Table 16 illustrates organizations using GPS to meet specific objectives.

Larger oil palm companies and research institutes (such as PT Musim Mas and IOPRI) use GIS techniques for effective management operations to address soil type, water availability etc. Using GIS and remote sensing techniques for environmental monitoring in the forestry sector is increasingly common but to date appears not to have been applied in policy planning for biofuels to address environmental issues within agriculture.

**Table 16: An illustration of institutions and activities for GPS and GIS activities.**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS for remote sensing</td>
<td>BAKOSURTANAL, BPN, PBB and private</td>
</tr>
<tr>
<td>GPS for GIS</td>
<td>BAKOSURTANAL, BPN, PBB, Ministry of Forestry, KLH, Institut Teknologi Bandung and private</td>
</tr>
<tr>
<td>Boundary determination and demarcation (district, provincial, national &amp; international)</td>
<td>BAKOSURTANAL, BPN, Dittop TNI AD, Topdam, Dishidros TNI-AL, Pemda</td>
</tr>
<tr>
<td>Determination and reconstruction of land parcel boundaries</td>
<td>BPN and private</td>
</tr>
<tr>
<td>Establishment of Forestry control network and co-ordinating forest land boundary points</td>
<td>Ministry of Forestry</td>
</tr>
<tr>
<td>Establishment of the Indonesian CORS</td>
<td>Potential - BAKOSURTANAL</td>
</tr>
</tbody>
</table>

1 BAKOSURTANAL is an organisation that conducts government tasks in the field of survey and mapping based on valid regulations.

Source: (Abidin, _)

Identifying peat soils: Peatland datasets used for this study are published by Wetlands International and at a national scale. More detailed regional datasets that are digitized were not located. This limits the use of the more locally explicit mapping.

Land Cover: Data on land cover is critical. The Ministry of Forestry produces land cover assessments but irregularly. Without such nationally available data, international datasets such as MODIS\textsuperscript{15} could be used. These datasets use transparent rules to interpret the imagery into land classifications. However, the resolution of this data could be too low for appropriate risk assessments and monitoring. Landsat data are freely available and at around 30m scale but would require substantial resource to interpret and classify land cover at a national scale. It could be used for monitoring at a more regional and local scale.

Existing monitoring systems within Indonesia, such as the Forest Monitoring and Assessment System (FOMAS)\textsuperscript{16}, should be explored and leveraged where possible. New technologies including a multi-sensor approach for systematic wide area monitoring of tropical forests at high resolution will assist the monitoring for biofuel sustainability criteria. High resolution data is required to detect selective forest degradation as opposed to large-scale clearcuts.

Using ‘degraded’ land
The current debate around the sustainability of biofuels is focused on land use change (both direct and indirect), as some of these changes are sufficient to negate any GHG savings that biofuels offer. In order to reduce additional pressure on land for biofuel production, many advocate the use of ‘degraded’ land.

Land categories in Indonesia may not be aligned with the concept of ‘degraded’ land as discussed by sustainability standards. The following box represents common definitions in Indonesia.

\begin{itemize}
\item \textsuperscript{15} http://modis-land.gsfc.nasa.gov/landcover.htm
\item \textsuperscript{16} http://www.sekala.net/guidance.php?cnt=International&lang=English&mID=4&cID=11
\end{itemize}
Economics of ‘degraded land’

A recent study (Fairhurst & McLaughlin, 2009) has illustrated oil palm costs of production on different land types. It demonstrates that producing oil palm on ‘degraded land’ or alang-alang is financially viable (Table 17). Heathlands on soil with high water retention characteristics (such as peatland) require substantial drainage and have lower yields and higher operating costs, resulting in greater CPO breakeven prices. Effective water management is critical to the success of economically viable developments, including on peatland (which requires the water table to be maintained at 60cm deep for root development in order to ensure shrinkage of the soil and subsidence does not occur). Drainage ditches and floodgates are required and add to the infrastructure costs.

Table 17: Summary of financials for oil palm on different land types

<table>
<thead>
<tr>
<th></th>
<th>Alang-alang*</th>
<th>Flat (secondary forest)*</th>
<th>Hilly (secondary forest)*</th>
<th>Heathland**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Present Value (15% interest rate)</td>
<td>258</td>
<td>-66</td>
<td>-1929</td>
<td>-3576</td>
</tr>
<tr>
<td>Breakeven price ($/tonne CPO)</td>
<td>482</td>
<td>505</td>
<td>644</td>
<td>839</td>
</tr>
<tr>
<td>Planting and establishment costs ($/ha)</td>
<td>3,685</td>
<td>3,954</td>
<td>4,984</td>
<td>4,637</td>
</tr>
<tr>
<td>Operating costs ($/ha)</td>
<td>1,260</td>
<td>1,260</td>
<td>1,432</td>
<td>1,928</td>
</tr>
<tr>
<td>Average FFB yield yr 8-15 (t/ha)</td>
<td>26.8</td>
<td>26.8</td>
<td>25.4</td>
<td>20.8</td>
</tr>
<tr>
<td>Average oil extraction rate from FFB</td>
<td>23.6%</td>
<td>23.6%</td>
<td>23.6%</td>
<td>23.6%</td>
</tr>
</tbody>
</table>

* Ultisol soil type (lower water retention characteristics)
** Spodosol soil type (high water retention characteristics)

Source: (Fairhurst & McLaughlin, 2009)
Some peat soils have greater costs of production and therefore lower returns per hectare than other soils. Good yields require adequate nutrient inputs; peat soils often have low nutrient content and high acidity and therefore the operating costs to manage fertilizer inputs can be considerably greater than that of mineral soils but could vary between US$792-932 for peat soils and US$699-835 for mineral soils (based on data from IOPRI, 2008).

So why are peatlands cultivated? First, certain types of peatland do have a good productivity potential and are found in flat terrain so could offer lower risks in development compared to other lands available, such as those with high slopes which could lead to erosion of roads etc. In addition, the land classification system and subsequent bureaucratic arrangements (identified below) mean high risk for project developers on some land types. Second, land rights conflicts are less likely to take place in areas that are less habitable and hospitable – such as the peatland areas. Economic analyses alone will not provide the full picture of land use decisions.

Land use, cover, classification and availability
Land classification is administratively defined and therefore is not the same as land cover or land use. Forest Land, for example, on some maps is not necessarily forested land. Using maps to identify land classifications and potential land availability is problematic. A spatial plan exists at the National Scale and spatial plans exist of the provincial scale. The national scale map is not a consolidation of all provincial scale maps so cannot be relied on as accurate for implementation at the provincial scale. The spatial plans are dynamic – the Ministry of Forestry, for example, has not developed (or released) the latest spatial plan and therefore the one that is used is from around 1999 despite the fact that provincial maps have changed in that time. In addition, a ‘plan’ does not equate to a strategy – many of the land classifications are retrospective.

The Ministry of Forestry is responsible for land under Permanent Forest Status. These lands are further classified into:
- Conservation Forest - designated for wildlife or habitat protection.
- Protection Forest (HL – Hutan Lindung) – to preserve environmental functions, protect watersheds as well as avoid negative impacts such as soil erosion.
- Production Forest – falls within the boundaries of a timber concession (intended to be logged at a rate that regrowth sustains operations)
- Limited Production Forest (HPT - Hutan Produksi Terbatas) – for low-intensity timber production
- Conversion Forest (Hutan Produksi Konversi) – under an IPK license this forest can be cleared and converted to another form of land use (timber or estate crop). If converted to agriculture this land becomes reclassified in future spatial maps\(^{17}\). Other licences (HPH and HTI - Hutan tanaman industri) were related to uses of the land for forestry purposes.

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\(^{17}\) Since 1999, licenses are either (a) Forest Product Utilization license (IUPHHK) or (b) Non Forest Product Utilization license (IUPHHNK). They are issued at the district level by district heads (Bupati). Previously, an
This land classification and associated governance issues are major challenges in promoting sustainable land use policies. Alang-alang is often used as a proxy for ‘degraded’ land as this was previously forested area. Box 4 illustrates how the land classification system is a challenge.

**Box 4: Land classification and the use of ‘degraded’ land**

The alang-alang is classified as ‘Forest land’ under the control of the Ministry of Forestry. It may have been forest in the 1970s but is now degraded. It is classified as ‘conservation forest’ or ‘productive forest’ (only forestry activities can be developed – this land cannot be used for agricultural purposes unless permission has been granted by Ministry Forestry and subsequently the reallocation has taken place).

To use this land for biofuel feedstock there are two options:

a) Provincial Government could request the change of classification from ‘conservation forest’ (now alang-alang) to ‘productive forest’ for tree related projects or;

b) Provincial Government could request change of allocation from forestry to an agricultural for use for biofuel feedstock – this would mean Ministry Forestry forgoes this land and the tax associated with any concession. This could take a minimum of 2 years and has a high degree of risk associated. New businesses looking for land are unlikely to look favourably on this procedure.

But, if the alang-alang already falls under an active concession licence then it will be very hard to re-allocate/ re-classify. The easiest way to promote the development of this land (over other land) is to work with the company who has the concession to develop these areas.

The alang-alang may be in an area outside of the ‘forest land’, i.e. outside of the control of the Ministry of Forestry and therefore is not encumbered with the same re-classification issues. This is the area with more immediate opportunity for new development. WWF Indonesia & Ecofys are currently undertaking a project to assist in developing a methodology that is intended to identifying ‘Responsible Cultivation Areas’ in Indonesia.

The Government plans to use inactive concessions for biofuel production (Bahan Bakar Nabati, 2006). HTI Licenses for industrial forestry are allocated for “marginal” or “degraded” forest areas. Currently there are 235 HTI companies covering 9,158,926 ha, with Riau, South Sumatera, East Kalimantan, West Kalimantan and Papua having the largest areas of HTI. However, up to two-thirds of HTI allocation remains unplanted; only 3.22 million ha had been planted as of July 2007 (PT Hatfield & IFC, 2009). If the remaining 5.9mha were planted for oil palm this could produce **15.1bn**
liters of biodiesel, enough to meet the biodiesel requirement in 2025. However, this does not take into account issues of land rights that will inevitably exist in these areas.

‘Degraded land’ and carbon stocks
A recent study has illustrated the differing soil carbon stocks of imperata grasslands, sometimes referred to as ‘degraded land’. The total soil carbon stocks in Kalimantan (fixed mass, approximate depth section 40 cm) were reported as 36.19 ton ha\(^{-1}\) in *Imperata* grassland, 38.98 ton ha\(^{-1}\) in secondary forest and 33.19 ton ha\(^{-1}\) in primary forest. Differences in the microclimate between ecosystems may affect carbon stocks. In the primary forests, for example, where the atmosphere is very moist and temperatures are relatively low and constant decomposition will probably be faster. In *Imperata* grassland the humidity is lower and the day temperature is relatively high and periodic drought is an impediment to decay. Table 18 illustrates that the carbon stocks of ‘degraded land’ in Papua New Guinea may be substantially higher than those in East Kalimantan and Sumatra – this will affect the carbon payback times of converting such ‘degraded’ land to biofuels.

**Table 18: Carbon stocks of imperata grassland in selected locations**

<table>
<thead>
<tr>
<th>Location</th>
<th>Aboveground biomass (ton ha(^{-1}))</th>
<th>C stocks aboveground (ton ha(^{-1}))</th>
<th>Soil carbon stocks (ton ha(^{-1}))</th>
<th>Total carbon stocks (ton ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papua New Guinea</td>
<td>–</td>
<td>6.7</td>
<td>85.7</td>
<td>92.4</td>
</tr>
<tr>
<td>Sumatra</td>
<td>–</td>
<td>2.4</td>
<td>44.6</td>
<td>47</td>
</tr>
<tr>
<td>East Kalimantan</td>
<td>7.5</td>
<td>3.45</td>
<td>36.19</td>
<td>39.64</td>
</tr>
</tbody>
</table>

Source: Kamp, Yassir, & Buurman, 2009

**Biological diversity**
Indonesia ranks first in the world for number of mammals, palms, swallowtail butterfly, and parrot species as well as being the center of plant species diversity for a number of genera. Because of the multiple threats to its forests and their associated biodiversity (the rate of deforestation in Indonesia in 2003 was the highest in the world), Indonesia has been identified by all recent international priority-setting exercises, as a global priority for actions to conserve biodiversity. The World Bank predicts that all lowland rainforests outside protected areas will be degraded in Sumatra by 2005 and in Kalimantan by 2010. Lowland forests throughout Indonesia are the most biodiverse habitats, but are also under greatest threat from habitat loss, fragmentation and degradation, over-exploitation of resources, and secondary extinctions (Rhee et al, 2004).

While Protected Areas are identified, there are risks to their status from development of oil palm (Figure 18).
Institutional capacity to address and monitor biodiversity

The Indonesian Biodiversity Strategy and Action Plan (IBSAP 2003) through 2020 was formulated by BAPPENAS and stakeholders to answer the challenge of making sustainable management and use of biodiversity for the prosperity of the Indonesian people a reality (Rhee et al, 2004). While the Ministry of Environment is the national focal point for the implementation of Convention on Biological Diversity (ratified by Indonesia), the Ministry of Forestry is one of the primary agencies with responsibilities for biodiversity conservation and preservation and management of forest resources. The Ministry of Forestry is responsible for the system of national parks and other protected areas. It is also the implementing agency for the Basic Forestry Law (1999) and for the Law on Conservation of Biodiversity and Ecosystems (1990) and for administration and management of 68% of the land area of Indonesia. The Ministry of Forestry lacks the financial and human resources (as do the provinces and districts) to properly manage Protected Areas (Rhee et al, 2004). Lack of coordination between Ministries and the decentralization of authority for implementation has slowed progress in addressing biological diversity.

The Indonesian National Biodiversity Information Network (NBIN) is an information network on biological diversity in Indonesia. It was established in the Ministry of Environment as a National Focal Point for the Convention on Biological Diversity in Indonesia. The aim is to create a practical mechanism to exchange data and information on biodiversity and it intends to become an independent network in the long-term. This information network is placed under the Indonesian Institute of Sciences (LIPI) and aims to become a center for references on conservation, research and
use of biodiversity, a connection gate to global information network on biodiversity, a mechanism to enhance information flow on biodiversity and a structured means to respond to user need on biodiversity. The objective of Indonesian NBIN is to provide information on biodiversity in a format, quality and accessibility that will enable plan and decision makers to use natural resources wisely in Indonesia. However, the only meta-data currently available online are related to fisheries, aquaculture and sea habitat.

At regional and site scales for assessment and monitoring a High Conservation Value approach has been defined (see www.hcvnetwork.org) and is in use within the RSPO for managing local impacts. The designation of ‘High Conservation Value’ was originally devised in the context of forest certification (HCVF) and is used within the Forest Stewardship Council, although it is applicable to all kinds of ecosystems and habitats. The Global Toolkit lists the following six ‘High Conservation Values’ (‘HCVs’) which cover a range of conservation priorities including social priorities.

National interpretations are key to implementation of the HCV toolkit and the Indonesian national interpretation is complete. GIS techniques and tools have been used as part of an HCV assessment within local and site-specific contexts and develop management plans e.g. a local assessment of spatial estimation of forest areas and watersheds, identifying both unique sources of drinking water. (Sulistioadi et al, 2004). These techniques enable better choices and practices to be identified within a specific context. Local Indonesian consultants (independent and within universities such as IPB) are carrying out this work.

**Water use and Water quality**

The amount of water in Indonesia fluctuates by season and is distributed differently among the regions. In certain areas occasional water shortages or droughts take place. Renewable water in Java is only 1,540 m³/person/year, compared to the Indonesian average of 15,600 m³/person/year, because of the high population density. In Indonesia, roughly 93 percent of utilized freshwater resources are withdrawn for irrigation: 6 percent is for domestic and 1 percent is for industrial use. (Rodgers & Hellegers, 2005).

At a high level, water footprints can be calculated to illustrate the water use per unit of crop or biofuel. Methodologies for water footprint calculations differ. For instance, how water is allocated to the residues or trunks of oil palm as opposed to the CPO used to produce the biofuel impacts results. Furthermore, in processing the biofuel, how water is allocated across other co-products, such as glycerine, also affects results. The water footprint for oil palm for example, can range from 235-326m³/GJ biofuel or 46m³/GJ bioenergy according to different methodologies (see Winrock water white paper in this series).

Many parts of Indonesia have suitable climates for rainfed agriculture and are not classed as water scarce: so does reducing the water footprint deliver a sustainable outcome?
Understanding the interconnectedness and interdependence of water use within river basins is essential to understand sustainable outcomes for biofuels. Increasing population will increase domestic water requirements and competition among sectors such as agriculture, domestic, municipalities and industry for limited water is becoming more intense. Conservation measures such as ‘saving’ water in one part of a basin can lead to shortages in another which can have negative unintended outcomes. Changing land use in parts of river basins can change evapotranspiration rates and affect the hydrology of the basin and availability of water for users downstream. Proposals to convert “degraded” land to biofuel plantations have not yet explored potential hydrological implications.

Upland areas play an important role as watersheds in the conservation of water resources and the maintenance of a stable ecosystem and are therefore key to the successful utilization of land resources in Indonesia. An integrated farming systems approach based on perennial crops and livestock (not on food crops, which tends to be a high-input high-risk activity in uplands) has been explored to counter these problems and biofuels may be able to play a role here.

**Institutional capacity to address water issues**

The Indonesian Parliament passed the Water Resources Bill on 19th February 2004, with the principle that water could no longer be regarded as being free as well as establishing a right-based legal and institutional framework for the management of water resources and irrigation. Proposals include the formation of a coordinating body for water, a national framework for the collection of hydrological data, the development of Provincial Basin Management Units in eight provinces and the development of autonomous and self-financing water user associations (WUAs) to manage Indonesia's vast irrigation networks.

The Law mandates that surface water management be based in river basins, where integrated water resources management can be introduced. The law also specifies that government and regional governments shall manage a water resources information system to support water management. The information system should include data on hydrological, hydro-meteorological, hydro-geological conditions, water resources policies, water resources infrastructure, water resources technology and water-related social, economic, and cultural activities of communities that rely on the river basin. It is widely agreed that institutional capacity requirements to strengthen water resource management are large and growing. Biofuel development as a potential added pressure on water resources should be a further catalyst to support institutional strengthening. The development of Geographic Information Systems could support effective development by providing accurate and reliable data and information on past situations, the current status, and changes that have occurred as well as simulating planned developments and showing interrelations between sectors and regions to visualize the scope and effects of planned programs and projects.

On a site-scale, there is experience in developing management practices to address water retention in soil. Oil palm planters in various areas such as Lampung, South Sumatra and South Kalimantan are often faced with drought. It is therefore necessary to maximize the use of rainfall by reducing
runoff. The application of soil water conservation techniques such as the construction of silt pit and soil bed is widely practiced (IOPRI, 2008).

7.4 Socio-economic issues & institutional capacity

Business models

Biofuel
Initially, biodiesel plants were small to medium sized entrepreneurial enterprises. The trend though, has moved towards larger scale ventures. Wilmar for example, has the largest production capacity in the country at 1mt/yr, compared to the smaller producers around 10,000-50,000t/yr. From the current 12 biodiesel producers in Indonesia, around 7 are vertically integrated and own feedstock as well as biofuel production facilities (Tjakrawan, pers comm.). Plants that are not vertically integrated and were built without firm supply contracts for their feedstock have suffered from the recent price volatility for CPO.

The bioethanol industry in Indonesia is focused on beverage alcohol production and is reliant on molasses. Molasses is therefore, one of the most likely bioethanol feedstocks. In 2004, molasses was cheap and plentiful and the sugar industry was trying to export the product. In the first three months of 2009, prices have risen from $70/t to $130/t (Tjakrawan, pers comm.). Bioethanol business models that rely on molasses into the future may also be set for further challenges. The proposed revitalization of the sugar sector to improve efficiencies will impact the quality of molasses. Owing to inefficiencies in the sugar production process, ethanol yields benefit from residual sugars in the molasses and will be reduced if sugar mill efficiencies improve. Two of the four current bioethanol producers are vertically integrated (Tjakrawan, pers comm.). There are currently no medium to large bioethanol projects, such as those found in Brazil or within southeast Asia, similar to those being developed in the Philippines, Vietnam and Thailand.

The role of State-Owned enterprises in Indonesia is significant. Within the energy sector, Pertamina is the national oil and gas company (PT Pertamina) with a mandate to blend biofuel into their supplies, and PLN is the national electricity company obligated to purchase biofuel for electricity generation purposes.

Palm Oil
Within the agriculture sector, the government owns plantations, referred to as Perusahaan Terbatas Perkebunan Nasional (PTPN), which are para-statal companies, wholly owned by the State. These operate in all parts of Indonesia, exploiting a wide range of natural resource products such as tea, cinnamon, cloves and palm oil. PTPN used to control the majority of oil palm plantation land in Indonesia but the role of these Government plantations is now substantially smaller (11% of planted hectares and 14% of production), as illustrated in Figure 19. Smallholders¹⁸ now play a significant role in the oil palm industry. In 2007 they represented approximately 41% of the total area under oil palm

¹⁸ The RSPO defines smallholders as family-based enterprises producing palm oil from less than 50 ha of land
but in general have lower yields therefore represented only 34% of the total production (in tonnes). The smallholders may be part of a plasma scheme or may be independent. The private sector accounted for 48% of the planted hectares to oil palm and, owing to high yields, 51% of CPO production in 2007.

**Figure 19: Relative shares of planted oil palm areas by different sector players (hectares)**

![Graph showing relative shares of planted oil palm areas by different sector players (hectares) from 2000 to 2007.]

Source: (IPOB, 2008)

Table 19 illustrates that the private sector has a key role in future development for oil palm plantations. Land holdings are substantially greater than the current planted area, and should further expansion into these land banks be undertaken, substantial opportunities for agroecological zoning could ensure the sustainable development of these areas.

**Table 19: Land holdings and oil palm area of key private sector groups in Indonesia illustrate substantial areas for potential expansion and for incorporating sustainable land use planning**

<table>
<thead>
<tr>
<th>Company/group</th>
<th>Land bank (ha)</th>
<th>Planted area oil palm (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golden Agri/SMART</td>
<td>1,300,000</td>
<td>359,732</td>
</tr>
<tr>
<td>Indofood Agri Resources</td>
<td>570,000</td>
<td>374,000</td>
</tr>
<tr>
<td>Asian Agri</td>
<td>515,000</td>
<td>170,000</td>
</tr>
<tr>
<td>Wilmar International</td>
<td>573,000</td>
<td>n/a</td>
</tr>
<tr>
<td>Astra International</td>
<td>500,000</td>
<td>238,000</td>
</tr>
<tr>
<td>Company/ group</td>
<td>Land bank (ha)</td>
<td>Planted area oil palm (ha)</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>----------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Minamas Gemilang</td>
<td>288,000</td>
<td>n/a</td>
</tr>
<tr>
<td>Ciliandra Group</td>
<td>278,000</td>
<td>86,000</td>
</tr>
<tr>
<td>Bakrie Sumatra Plantation</td>
<td>210,000</td>
<td>78,000</td>
</tr>
<tr>
<td>Tri Putra Agro Persada</td>
<td>200,000</td>
<td>120,000</td>
</tr>
<tr>
<td>Bumitama Gunajaya/ Harita Group</td>
<td>200,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Duta Palm Group</td>
<td>200,000</td>
<td>54,000</td>
</tr>
<tr>
<td>Lyman Agro</td>
<td>190,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Sampoerna Agro</td>
<td>182,000</td>
<td>78,000</td>
</tr>
<tr>
<td>Incasi Raya Group</td>
<td>174,000</td>
<td>36,000</td>
</tr>
<tr>
<td>Golden Hope</td>
<td>170,000</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Total undeveloped oil palm (ha)</strong></td>
<td></td>
<td><strong>3,866,268</strong></td>
</tr>
</tbody>
</table>

Source: Jakarta Globe, 2009

**Individual/ independent smallgrowers**

These are growers who cultivate palm oil without direct assistance from government or private companies. They sell their crops to local mills either directly or through buyers. With generally lower access to capital, individual smallholders often have lower yielding palm varieties. Many extension programs are supported by IOPRI and implemented by the Local Dinas which are now almost exclusively under the control and financial jurisdiction of Bupati (heads of regencies) (Colchester, et al., 2006). The Bupatis' interest in rural improvement significantly influences the potential for individual smallgrowers to achieve the yield increases that biofuel sustainability standards (and others) would like to see. Independent smallgrowers continue to establish plantations and may do so on allocated peatland / wetland (that the EU does not permit for access to their biofuel markets). These smallholders approach local mills that are required to take a percentage of their FFBs from smallgrowers. The bargaining power of the purchasers may be increased through the smallholder's inability to demonstrate compliance with these new market access requirements based on sustainability criteria.

**Other smallgrowers**

**Inti-Plasma:** Between 1978 and 2001, the Government of Indonesia provided policy support and the World Bank provided financial support to nucleus-plasma supported grower schemes. In these schemes plantation companies would develop palm oil plots for smallholders in a 'plasma' area around their own plantation 'nucleus'. Management of plasma plots, generally 2 ha of oil palm plus 1 ha for other crops, would be transferred to individual smallholders after 3-4 years. The nucleus-plasma schemes were part of the government's resettlement (transmigrasi) program, through which Javanese and Sumatran people moved to start a new life in the less populated islands (Vermeulen & Goad, 2006). There has been no further government-sponsored expansion of these units since 2001.

**KKPA:** The Government introduced the KKPA (Koperasi Kredit Primer Anggota: Members’ Primary Credit Co-operative) scheme to integrate local landowners into new plantation developments. Local landowners participating in the scheme needed to provide approximately one-third of their land to the
company’s nucleus estate while the remaining two-thirds was developed and returned to them in the form of an oil palm smallholding in the “satellite” area. These smallholders are contractually obliged to sell FFBs to the buyer who sets prices (local government representatives are supposed to be present at weekly meetings to ensure price transparency).

The scheme allowed formalized local cooperatives to borrow up to a maximum of IDR50 million ($5,000), at a partially subsidized repayment rate of 16% for small business development (Vermeulen & Goad, 2006). Some of the problems reported in the scheme have significant relevance understanding outcomes for biofuel sustainability: positive cash flows do not occur until the fifth year of an oil palm development so it is necessary to have an alternative source of income to meet the financial demands of establishing oil palm in addition to providing for the basic needs of family members. Although traditional intercropping in the KKPA scheme is disallowed, it could be beneficial; for the first three years after planting there is an opportunity to intercrop soybean with oil palm to earn income while palms mature (IOPRI, 2008).

**Joint Venture schemes (Pola Patungan).** These schemes give local residents, who are settlers under the Indonesian transmigration program, share certificates for their 2 ha, rather than allocating an actual block of land. Shareholders are then given the choice of working either in the plasma under the cooperative, trained by the plantation company, or in the nucleus staff. The revenues are shared on the basis of certificates rather than on the basis of the performance of individual blocks which can differ widely.

**Sugarcane**

There are 59 sugar factories in Indonesia with crushing capacities ranging from 1,000 to 12,000 metric tons of cane per day (TCD). Forty-six factories are owned by only six companies. Sixty-three percent of the crushing capacity (124,263 TCD) is on Java (particularly East Java), and 72,512 TCD crushing capacity is on the outer islands. Many sugar mill factories on Java are old factories, which operate inefficiently due to the old machines used.

Indonesian sugar is strictly regulated by the government. Raw sugar can only be imported by refineries where it will be used as the raw material for refined sugar production. Only the food and beverages industry can import refined sugar, and it must be of a quality that cannot be produced domestically.

Indonesia has become the second largest sugar importer from a position as second largest producer. Not only have hectares decreased on average by around 90,000ha from 1995-2007 but yield has also decreased down from around 77 t/ha in the 1990s to around 63 tons in the 2000s. Government policies that removed programs for and controls over agricultural production are reported to have contributed to the decline as farmers now grow cane for around six years before replanting rather than the recommended four years which negatively affects yields. The Ministry of Agriculture has launched a government-funded rehabilitation program to provide sugarcane farmers with high-yield seeds worth around Rp68 billion ($8 million) in grants and Rp1 trillion in soft loans to help them replant their fields using new seeds. Business Model 1, below, shows that the sugar mill receives the
subsidy. In 2003/4 the Government-set price for planting material was Rp1.5m/ha and the sugar factories were selling planting material for Rp950.00/ha.

**Business Model 1:** The most common business model on Java is a sharing agreement between the mill and farmer of the revenues from sugar (it varies but typically is 34% to the factory and 66% to the farmer). After the sugarcane enters the factory, it is analyzed to determine the trash composition (a maximum of 7% of trash is allowed) and then the factory calculates the ratio of production (RoP). The planting material is supplied by the mill with which the farmer has an agreement.

**Business Model 2:** In other regions the farmer would lease or own the land, undertake planting and harvesting and retain 100% of the revenues.

Farmers are paid on the basis of average sugar content of delivered cane with quality premiums or discounts. Based on a 6t/ha sugar production, values for sugar at the Government-set floor price for 2009 and current high price19 and a 60% share if the value for the farmers, returns for sugarcane are in the region of US$1900 - $2600/ha.

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**Box 5: Bioethanol, electricity and energy security**

Over 8Mt bagasse is currently produced in Indonesia and around 90% is utilized (usually inefficiently in low pressure boilers) as fuel for the boiler, while some bagasse is used for paper production or mushroom cultivation and the rest is left unutilized (P.T. Chazaro Gerbang Internasional, 2006). There is only one sugar mill in Indonesia with a high pressure boiler (and this is only 50bar) with the rest of sugar mills at a 22 bar boiler pressure. Most new and upgraded sugar mills in India, which has over the last 15 years become one of the most technically advanced sugar milling countries worldwide, have adopted 85 bar or 105 bar boilers. Higher pressure boilers mean that substantial quantities of electricity for export can be produced. In addition, sugar mills can be upgraded to be more energy efficient. This further increases potential electricity exports subject, of course to a grid connection cable of handling the exportable power. A plant designed to mill at an average of 2500 TCD (average size for Indonesia) and produce raw sugar could be designed to export about 10 MWe. A similarly sized plant producing ethanol would require more process energy but could still export about 7 MWe. By selecting locations where connections to loads are adequate, new ethanol and electricity projects could be pioneered.

Sugarcane can be an economically attractive crop but there are several issues of concern in Indonesia. The Government is focusing on sugar self-sufficiency and many do not expect much of the sugarcane ethanol to be developed on Java owing to pressures on land. On islands other than Java, labor availability is a problem and therefore the development of biofuels based on sugarcane may be problematic as lower labor allocation affects the levels of productivity of sugarcane which is a critical

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factor in economic sustainability. Mechanical harvesting could help to overcome this problem but incurs higher investment costs and therefore would affect the cost competitiveness of the biofuel. The Special Biofuel Zones identified only one region (Lampung) on Java for sugarcane and the remainder are on other islands (Table 5).

Table 20 shows that some of the socio-economic indicators of provinces in which sugarcane ethanol projects are proposed are particularly low and biofuel development could be a mechanism to contribute to improved socio-economic situations.

Table 20: Proposed bioethanol plant locations and indications of rural development status

<table>
<thead>
<tr>
<th>Facility</th>
<th>Location</th>
<th>Capacity (kl/yr)</th>
<th>HDI ranking (within Indonesia)</th>
<th>Unemployment* (%)</th>
<th>% households using pump/ well</th>
<th>% below poverty line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar Group</td>
<td>Lampung</td>
<td>500,000 (total)</td>
<td>19</td>
<td>6.3</td>
<td>67.3</td>
<td>22.2</td>
</tr>
<tr>
<td></td>
<td>Sumatra Selatan</td>
<td></td>
<td>13</td>
<td>8.5</td>
<td>57.9</td>
<td>19.2</td>
</tr>
<tr>
<td></td>
<td>Kalimantan*</td>
<td>5/6 or 26/28</td>
<td>4.8-11.4</td>
<td>50.9-68.4</td>
<td>7.0-12.9</td>
<td></td>
</tr>
<tr>
<td>Salim Group</td>
<td>Sumatra Selatan</td>
<td>70,000</td>
<td>13</td>
<td>8.5</td>
<td>57.9</td>
<td>19.2</td>
</tr>
<tr>
<td>Mitsui-Petrobras</td>
<td>Papua</td>
<td>500,000 (total)</td>
<td>33</td>
<td>4.85</td>
<td>58.6</td>
<td>40.8</td>
</tr>
<tr>
<td></td>
<td>Kalimantan*</td>
<td></td>
<td></td>
<td>4.8-11.4</td>
<td>50.9-68.4</td>
<td>7.0-12.9</td>
</tr>
<tr>
<td>RNI – PTPN</td>
<td>Sumatra utara,</td>
<td>200,000</td>
<td>8</td>
<td>9.6</td>
<td>51.5</td>
<td>13.9</td>
</tr>
<tr>
<td></td>
<td>Lampung,</td>
<td></td>
<td>19</td>
<td>6.3</td>
<td>67.3</td>
<td>22.2</td>
</tr>
<tr>
<td></td>
<td>Sulawesi</td>
<td></td>
<td>23</td>
<td>10.5</td>
<td>46.7</td>
<td>14.1</td>
</tr>
<tr>
<td></td>
<td>selatan,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jawa</td>
<td></td>
<td>14/16</td>
<td>7.1/ 12.3</td>
<td>42.5-57.0</td>
<td>13.6-20.4</td>
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<tr>
<td></td>
<td>NTT</td>
<td></td>
<td>31</td>
<td>3.7</td>
<td>63.9</td>
<td>27.5</td>
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<tr>
<td>Angel Product</td>
<td>Sulawasei</td>
<td>10,000</td>
<td>24</td>
<td>6.1</td>
<td>61.9</td>
<td>21.3</td>
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<td></td>
<td>Tengarra</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Wilmar Group</td>
<td>Lampung</td>
<td>70,000</td>
<td>19</td>
<td>6.3</td>
<td>67.3</td>
<td>22.2</td>
</tr>
<tr>
<td></td>
<td>Sulawesi</td>
<td></td>
<td>23</td>
<td>10.5</td>
<td>46.7</td>
<td>14.1</td>
</tr>
<tr>
<td>Satria, Bronzeoak</td>
<td>NTT</td>
<td>300,000</td>
<td>31</td>
<td>3.7</td>
<td>63.9</td>
<td>27.5</td>
</tr>
<tr>
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<td>Kalimantan*</td>
<td></td>
<td></td>
<td>4.79-11.41</td>
<td>50.9-68.4</td>
<td>7.0-12.9</td>
</tr>
</tbody>
</table>

* Results will vary according to location (East, West, Central). A range is shown from low to high.

** http://www.bps.go.id/leaflet/booklet_okt08.pdf?

*** page 35 of source above
Cassava: Intercropping of cassava is common in small landholdings such as on Java where it is often intercropped with upland rice and maize. After the rice and maize harvest, short-season grain legumes such as soybean, mungbean or cowpea are planted between rows in the space previously occupied by rice, which results in four crops per year. In other parts of Indonesia, cassava can be monocropped but requires substantial fertilization to avoid soil degradation. The Government is promoting cassava as a biofuel feedstock to meet domestic biofuel demands.

Jatropha. Substantial interest has been generated in jatropha and it is explicitly targeted within the domestic biofuel policy documentation despite the lack of commercial projects. According to local developers in Indonesia, a business model for jatropha based on biofuel production alone is not feasible. The oil is only a minor part of the revenue and therefore carbon financing and biogas produced from residues are required. Employment statistics vary depending on the business model from one farmer for every three hectares to four farmers per hectare.

Labor issues
Employment issues for Indonesia are a key driver of biofuel policy. Table 21 indicates levels of employment and illustrative returns per hectare (gross margin).

Table 21: Indicators of employment and returns per hectare per crop

<table>
<thead>
<tr>
<th></th>
<th>Sugarcane</th>
<th>Oil palm</th>
<th>Rice</th>
<th>Cassava</th>
<th>Jatropha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jobs/ha (direct)*</td>
<td>2-4</td>
<td>0.5*</td>
<td>200**</td>
<td>0.5*</td>
<td>0.33*-4</td>
</tr>
<tr>
<td>Gross margin ($/ha)**</td>
<td>1900-2600</td>
<td>1550-2100</td>
<td>110-1190</td>
<td>600*</td>
<td>66-450*</td>
</tr>
</tbody>
</table>

Note: Gross margin accounts for variable production costs and revenues only
* Data derived from Bahan Bakar Nabati, 2006
** Source: http://www.irri.org/science/cnyinfo/indonesia.asp
*** Based on single crop per hectare per year except high yield of rice which assumes 3 crops per year. Ranges refer to 60-85t/ha for sugarcane and 3-4tCPO/ha for oil palm. Rice estimates are obtained from literature.
Source: Calculated from various sources

Despite the lower employment per hectare, oil palm is a significant contributor to socio-economic development in many regions through its areal dominance. Assuming one direct job supports a family of four people, Figure 20 illustrates that oil palm can be estimated to support up to 57% of the population of Riau and 10% to 50% of the population in a further 11 regions, including over 45% in Jambi and Kalimantan Tengah.
Figure 20: Impact of oil palm industry on livelihoods (% of population supported by oil palm)

Institutional capacity to address labor issues

Child labor is regulated under the manpower law (no. 13 year 2003) and the law on child protection (no. 23 year 2002). Anyone under 18 years old is considered a child and is not allowed to work. However, the implementing regulation refers to employment in the formal sector and particularly refers to types of work that would “block the child’s access to education”. This regulation is designed to respond to the fact that many children help out their parents with their small-scale business in the informal sector, e.g. pushcart vendors, home manufacturers, etc. The enforcing ministry is the Ministry of Manpower (Departemen Ketenagakerjaan) where arbitrators and civilian investigators provide support for potential cases of violations. However, no child labor case has been formally

Source: Population data from BPS statistics and oil palm area from IPOB, 2008.
acted upon. Indonesia has a separate ministry for women empowerment, which coordinates children protection policy. However, the ministry is generally regarded as inept as it has not been equipped with enforcing power. Ministerial appointments are largely political ones.

**Land rights**

The expansion of oil palm in Indonesia has been the focus of considerable discussion surrounding social impacts and specifically lost access to land. The Indonesian Constitution respects the existence of customary law communities, acknowledges their right to be self-governing and recognizes their customary rights in land. Indonesia has also ratified some key pieces of international law which protect the rights of indigenous peoples and local communities. However, other laws provide only weak recognition of customary rights and allow government agencies a great deal of discretion in deciding whether to respect them or not (Colchester et al., 2006).

To prove land rights have not been infringed, adherence to the principle of Free, Prior and Informed Consent is required in a number of sustainability standards that are relevant for biofuels, such as the RSPO, RTRS and RSB (see Table 1).

**Institutional capacity to address land rights**

Provinces vary greatly in the extent to which local governments accept the rights in land of local communities, despite operating within the same national legal framework. They range from little recognition (West Kalimantan) to recognition but different interpretations (Lampung) and to recognition and community treated as rights holders (West Sumatera) (Colchester, et al., 2006). Procedures for titling such lands are absent, defective or rarely applied, and in many cases there do not appear to be any district regulations on customary rights recognition that would establish such procedures (Colchester et al., 2006).

There are no digitized maps of land rights or assessments that were publically available for use in this study to assess risks. Verifiers of sustainability standards use the BPN agency for land use related criteria to determine whether companies have legal right to the land. Laws which recognize indigenous rights and encourage land development for commercial projects in the ‘national interest’ lead to conflicting land title claims and it is possible for a piece of land to have two or three title claims.

NGOs such as SawitWatch and the Forest Peoples Programme play a key role in monitoring land rights issues. Publications such as a guide for companies, communities and local government to Free, Prior and Informed Consent include a synthesis of training materials about how successful procedures can be carried out in line with this principle. Other multi-stakeholder standard organizations such as the Roundtable on Sustainable Palm Oil have established standards that

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20 Established in 1998 with the stated aim of linking over forty Indonesia-wide NGOs in a coordinated network to raise awareness of the environmental and social impacts of irresponsible oil palm expansion.

21 [http://www.forestpeoples.org/documents/law_hr/fpic_and_rspo_companies_guide_oct08_eng.pdf](http://www.forestpeoples.org/documents/law_hr/fpic_and_rspo_companies_guide_oct08_eng.pdf)
reference the principle of Free, Prior and Informed Consent and are conducting and sponsoring training courses that attempt to educate the supply chain on its standard and how to operationalize its criteria.

Given the limited coverage of RSPO to date, it is vitally important to build capacity to address land rights within local governments. Assessments of the status of land rights in areas identified by national and local government as suitable for biofuel production would be the first step to identify potential risks.

**Food security and biofuels**

The 1996 Indonesian Constitution No. 7 concerning Food defines food security as “a condition where there is sufficient food for every household, which is reflected by availability of sufficient food, both in quantity and quality, that is safe, evenly distributed, and accessible\(^{22}\).”

For a number of standards discussing biofuels and food security, the production of biofuel feedstocks on existing cropland is deemed less than satisfactory as it is assumed to contribute to displacement of feed crops and therefore has negative implications for food security.

However, this simple approach to addressing food security masks a more complex scenario. Many governments’ policies on food production focus only on one or two main food commodities. The rice-based food policy of Indonesia has resulted in many non-ideal conditions for food security in Indonesia. Rice is now the dominant feature of consumers’ nutrient intake and therefore the Indonesian food system has a high dependency on rice. Emphasis on an increased production only has caused a reduced development of local food resources, less research investment into non-rice-based foods, and in turn makes dependency of rice even higher\(^{23}\).

The food security impacts of biofuel development could be positive in some cases. For example, in regions with a good climate for crop production but insufficient rural infrastructure, villages may have more than sufficient produce to meet their needs. The problem here is one of access to a market in which to sell food crops. If crop diversification away from food becomes an option, incomes could increase. Existing cropland used for biofuel may have a positive impact on food security by increasing income and enabling purchase of food on the market. The production of biofuel in a region can also assist in delivering energy security improvements by removing reliance on fossil fuels which improves fuel availability and reduces price volatility, which itself could mitigate negative food security impacts (Cotula et al, 2008). Poverty causes food insecurity and itself depends on income, productivity and employment. Distribution systems that connect food reserve institutions, markets, production centers, and settlement areas are very important for achieving household and regional food security. A food versus fuel assessment that only addresses land competition for biofuels is too simplistic.

\(^{22}\) This is largely in line with FAO definition related to availability, accessibility and affordability.

\(^{23}\) http://www.worldfoodscience.org/cms/?pid=1004751
Reconciling energy security, environmental issues and socio-economic development

The lack of capacity in Indonesia in which to blend intended volumes of biofuel is a key issue for meeting national energy security and socio-economic development goals. Refinery capacity is limited and therefore, for domestic sales, Pertamina blends at the fuel depot (as happens in Jakarta) but geographically disbursed terminals pose a challenge to final costs of biofuel. For access to the International market, Indonesia currently relies upon storage and blending facilities in Singapore, as it does not have its own deepwater port or suitable storage facilities.

At present, distribution systems for fossil fuels are unreliable and distribution costs are expensive. National energy security goals are challenged by a poor distributional infrastructure. As noted above, dependency on fossil fuels can have a strong poverty link. Decentralized production and distribution is necessary to reduce dependency on fossil fuels and meet socio-economic and energy security goals. Therefore, relying on this existing technical network with centralized production and subsequent distribution is unlikely to deliver on national energy security and socio-economic goals.

Figure 21: Fuel transportation logistics in Indonesia

Source: Indonesian Institute for Energy Economics, 2007

Environmental and social benefits of decentralizing biofuel development

Indonesia’s largest source of GHG emissions (excluding those associated with land use change) are associated with the use of fossil fuels for energy and transport. Indonesia’s electricity grid has a particularly high carbon intensity compared to others (a low value of 209gCO₂eq/MJ compared to Brazil’s of 34gCO₂eq/MJ) and therefore producing bioenergy from a biofuel system to displace fossil fuels would be even more beneficial for reducing GHG emissions compared with similar efforts elsewhere.
The oil palm industry plays a key role in the production of GHG emissions but also represents a substantial opportunity to reduce emissions. Figure 22 illustrates a sensitivity analysis for Indonesian palm oil based biodiesel (the CPO is shipped to the EU and converted into biodiesel) and illustrates the substantial role of co-products, yield improvements and POME in the GHG emissions balance. POME is the effluent from processing the fruits of oil palm and is generated mainly from oil extraction, washing and cleaning up. As water quality discharge guidelines and regulations have been implemented, POME is now frequently discharged first into open lagoons (without methane capture) where the wastewater is treated. Biological oxygen demand (BOD) is the key measurable parameter of water quality, and microbial activity in the anaerobic conditions – a natural process that reduces this BOD – produces methane as well (a GHG 25 times the global warming potential of carbon dioxide according to the 4th IPCC Assessment Report).

**Figure 22: Sensitivity analysis of GHGs from oil palm biodiesel**

Source: Based on RFA, 2007
Many sustainability standards are promoting a Life Cycle Analysis approach to calculating the GHG emissions associated with biofuels. Full carbon accounting data that would assist these activities are still scarce in Indonesia. Most lifecycle GHG emission calculations have been conducted in the EU and US (and some in Malaysia). The Indonesian Palm Oil Commission jointly cooperated with World Agroforestry Center (ICRAF), IOPRI, and the Netherlands on a new project on “Reducing GHG emissions associated with oil palm in Indonesia: accounting for greenhouse gas emissions over the full life cycle on peat and mineral soils and building capacity for and industry response to emerging environmental regulation in European markets” (IPOB, 2008).

Indonesia and represents around 17% of the emissions from power plants (93 million tonnes in 2007), around 24% of emissions in the transport sector (67.7 mt in 2005) and more than twice the emissions associated with gas flaring (7 mt in 2000).25

Biogas capture and by-product utilization could contribute to rural electrification but energy supply does not always match local demand and may not justify investment costs. The capital costs and amount of biogas production are the key parameters that influence payback times (Figure 23). The challenge initially is to find a business case for the investment. For mills that have a palm kernel crushing plant as well as a CPO plant, the energy requirements could be sufficient to make the investment worthwhile. With a local community close by, the energy availability from the methane would be much greater and the investment would be unattractive, despite the obvious benefit of using the methane for rural electrification. Carbon credits can assist in improving the payback periods but Indonesia has lacked capacity to capture CDM benefits. Neighbouring Malaysia has a greater number of POME-based CDM projects than Indonesia. Demonstration projects and capacity building to capture CDM (or voluntary carbon credits) is needed to realize these potential benefits.

One comprehensive study of the emissions of various biofuels (JEC, 2008) has calculated that biofuel production only saves 44% GHG emissions when compared to a fossil diesel if POME emissions are not captured (excluding emissions from land use change). However, if the POME gas emissions were captured and used, the GHG savings for the resulting biodiesel would be 72%.24

In 2007, there were 421 palm oil processing facilities in Indonesia with a capacity of 18,343 t FFB/hour. Without methane capture this could contribute approximately 13-16 million tonnes CO2eq/yr in GHG emissions. This is a substantial contribution to GHG emissions in Indonesia and represents around 17% of the emissions from power plants (93 million tonnes in 2007), around 24% of emissions in the transport sector (67.7 mt in 2005) and more than twice the emissions associated with gas flaring (7 mt in 2000).25

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24 This assumes a fossil fuel reference of 86 g CO2eq/MJ
Alternatively, the use of crude palm oil or jatropha oil within diesel generators is envisaged within the national biofuel policy and could have substantial benefits e.g. use in Lister engines to generate power in rural communities could be a substantial step towards improved economic prosperity and social well-being. Success of this approach depends on the quality of the straight vegetable oil and engine testing. There is no testing program that has resulted in clear guidance and engine approvals that would facilitate roll-out.

8.0 CONCLUSIONS

Biofuels represent a significant strategic resource in Indonesia. As a net fossil fuel importer and with substantial population growth and employment challenges, Indonesia’s main drivers for biofuels are to address national security through both energy security and poverty alleviation.

At present, Indonesia’s biofuel industry is intended primarily for domestic use and biofuels are unlikely to be traded in any volume. Market-driven approaches to incentivize ‘sustainable practices’ will likely be unsuccessful unless there are benefits to implementation of the standard, i.e. a domestic price support or premium. However, at present, biofuel production in Indonesia is uneconomic compared to subsidized fossil fuels. A biofuels subsidy is proposed to boost the biofuel industry. This subsidy is not linked to any social or environmental criteria for biofuels.
Decentralized control means that approaches to the issue differs across provinces and highlights the fact that engaging central Government departments alone to incentivize compliance with such standards will not be a single solution.

Regional biofuel production and use has local and national benefits that, given the distribution challenges and costs associated with a diverse archipelago, have a greater social relevance than environmental focus. However, economic challenges of biofuel production limit growth of the industry as a whole and compromise both energy security (owing to distribution issues) and poverty alleviation goals. While oil palm production has provided a substantial number of jobs and improved incomes for smallholders, a decentralized framework for biofuels based on regionally appropriate feedstocks has not developed and larger scale biodiesel operations are the outcomes of economic challenges. Reconciling energy security, environmental issues and socio-economic goals is possible but several key issues remain: the lack of institutional capacity and legal framework to address land rights and the absence of a co-ordinated bioenergy research agenda to assist in developing regionally appropriate bioenergy models.

Government institutions have a key role to play in delivering a sustainable biofuel policy but there are so many institutions with conflicting priorities that a lack of co-ordination will jeopardize the development of a biofuel industry and achieving energy security goals. Coordination challenges also appear in the biofuel research agenda which should be addressed to assist in delivering a comprehensive national strategy for biofuels from research through to implementation.

This desktop study and analysis illustrates that:

- The potential for biofuel production that meets high level environmental criteria appears large and could (in theory) meet all domestic fossil fuel requirements and enable sustainable exports
  - Key data limitations on land rights and highly biodiverse areas other than protected areas limit the robustness with which such conclusions can be made and, therefore, limits the potential to use GIS techniques for national land use planning.
  - There is a lack of supportive legal framework throughout Indonesia that adequately addresses the issue of land rights and land development. Without such a framework there is a substantial risk that energy security goals will directly conflict with those of socio-economic development.
- Areas of potential supply do not necessarily match availability of suitable infrastructure and will heavily influence economic viability e.g. Special Biofuel Zones defined for Papua.
  - Infrastructure plays a key role in limiting domestic goals for biofuels.
- Existing plans for expansion are greater than the ‘geophysical plus’ potential in some provinces.
- Existing oil palm concessions are located on areas that are deemed ‘unsustainable’ by the sustainability criteria established in the EU biofuels directive, but other areas within the concessions appear uninhibited by such criteria.
• Terminology in use within sustainability standards and within Indonesia may lead to confusion. For example, peat lands are often also referred to as ‘marginal lands’ owing to their economic returns. There is unlikely to be a single definition for any of these terms that is possible to apply globally and should be interpreted for national situations.

• Effective land use planning can play a significant role in avoiding GHG and biodiversity risks. The most immediate and effective route is to engage and collaborate with private and public organizations with large land concessions to effectively plan the land use for optimal economic, environmental and social benefit. There is a major role here for information dissemination through technology and networking. Provincial activities will play a key role and could provide the necessary anchors for technical advisory services as well as local resource inventories to establish locally appropriate feedstocks. Private and public organizations that engage with NGOs to develop effective land use planning proposals through participatory approaches are likely to deliver the single biggest impact in this area.

• Obtaining data in Indonesia is relatively difficult and useful maps may be expensive to purchase. Reliance on Government departments to provide this data is not necessarily ideal. An independent and accessible store of web-based information could be created (see Winrock, 2009 for a discussion of a wiki-style of geospatial information). A lack of geospatial data for some indicators inhibits the potential to develop cost-effective approaches to monitoring.

• Capacity building programs are needed for government institutions involved in developing and applying biofuel policy and should include training on remote sensing techniques and GIS, collation of existing methodologies and toolkits, developing a data repository for key country databases and providing long-term secure storage for these data. Further understanding of how existing capacity building programs could be leveraged (such as those no doubt underway for REDD) for a biofuel sustainability monitoring program to reduce costs of compliance with standards and to assist monitoring efforts would be a cost effective approach.

Finally, most regulatory standards are being developed with over-representation from developed nations. Regulatory standards (such as the EU Renewable Energy Directive) have not presently involved such participation and therefore a significant capacity gap exists for many stakeholders within Indonesia to address mandatory requirements for biofuel sustainability that have been created without broader participation. In order to develop effective standards, knowledge of the local context and drivers is essential in order to realise truly sustainable outcomes from biofuel development.
9.0 REFERENCES


Asia Pacific Energy Research Centre (APERC), 2006. APERC Energy Supply and Demand Outlook. 2006, Volumes 1&2, APERC.


Fairhurst, T., & McLaughlin, D. (2009). Sustainable Oil Palm Development on Degraded Land in Kalimantan. WWF.


10.0 ANNEX 1: GIS METHOD AND DATA

The area of the geophysical potential for growing sugar cane and oil palm was recorded and used to define the available countrywide area for growing sugar cane and oil palm trees after excluding forest and peat land, protected area and areas with high water erosion. Figure 24 shows the general flowchart of spatial procedure and rules for creating ‘Geophysical’ and ‘Geophysical Plus’ potential maps for growing sugar cane and oil palm trees. Table 23 and Table 24 report characteristics used to define geophysical potential of sugar cane and oil palm tree cultivation.

Table 22: Data sources

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<tr>
<th>Spatial dataset</th>
<th>Original Scale/ Resolution</th>
<th>Source/ Reference</th>
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<tr>
<td>(1) Landcover data</td>
<td>Country scale</td>
<td>Ministry of Forestry, Indonesia</td>
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<tr>
<td>(2) Soil type</td>
<td>Global scale/ 1:5,000,000/ shapefile</td>
<td>US Department of Agriculture Natural / USDA Resources Conservation Services Global. Soil Regions. 2006. Soil Survey Division</td>
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<td>(6) World Database on Protected Areas (WDPA)</td>
<td></td>
<td>‘World Database on Protected Areas (WDPA) Annual Release 2009 (web download version), February 2009. The WDPA is a joint product of UNEP and IUCN, prepared by UNEP-WCMC, supported by IUCN WCPA and working with Governments, the Secretariats of MEAs and collaborating NGOs (dataset obtained April 25, 2009 from URL: <a href="http://www.unep-wcmc.org">http://www.unep-wcmc.org</a>)</td>
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Table 23: Rainfall and slope characteristics used in the analysis for identifying ‘geophysical’ potential for sugar cane cultivation

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<th>Characteristic</th>
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<td>Slope (%)</td>
<td>&lt;15</td>
<td>&lt;15</td>
<td>&lt;15</td>
<td>&lt;15</td>
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</table>

Table 24: Rainfall and slope characteristics used in the analysis for identifying ‘geophysical plus’ potential for oil palm tree cultivation

<table>
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<td>Rainfall (mm)</td>
<td>1750-3000</td>
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<td>Slope (%)</td>
<td>&lt;8</td>
</tr>
</tbody>
</table>

Source: Modul M-100-203 : Kulture Teknis Kelapa Sawit (Palm Oil Cultivation), IOPRI, 2005.

Table 25: Soil orders and soil suborders and their suitability to maintain sugarcane and oil palm crops based on soil texture and type.

<table>
<thead>
<tr>
<th>Soil orders</th>
<th>Soil suborders</th>
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<td>Alfisols</td>
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<td></td>
</tr>
<tr>
<td>Oxisols</td>
<td>Perox</td>
<td>Suitable</td>
<td>Suitable</td>
</tr>
<tr>
<td></td>
<td>Udox</td>
<td>Suitable</td>
<td>Suitable</td>
</tr>
<tr>
<td></td>
<td>Ustox</td>
<td>Suitable</td>
<td>No</td>
</tr>
<tr>
<td>Spodosols</td>
<td>Aquods</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Humods</td>
<td>Suitable</td>
<td>Suitable</td>
</tr>
<tr>
<td></td>
<td>Orthods</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Ultisols</td>
<td>Aquults</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Humults</td>
<td>Suitable</td>
<td>Suitable</td>
</tr>
<tr>
<td></td>
<td>Udults</td>
<td>Suitable</td>
<td>Suitable</td>
</tr>
<tr>
<td></td>
<td>Ustults</td>
<td>Suitable</td>
<td>No</td>
</tr>
<tr>
<td>Vertisols</td>
<td>Aquerts</td>
<td>Suitable</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Uderts</td>
<td>Suitable</td>
<td>Suitable</td>
</tr>
<tr>
<td>Soil orders</td>
<td>Soil suborders</td>
<td>Suitable for sugarcane</td>
<td>Suitable for Oil Palm</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Usterts</td>
<td>Suitable</td>
<td>Suitable</td>
<td>Suitable</td>
</tr>
</tbody>
</table>

**Figure 24:** Flow chart of spatial analysis for identifying area with ‘Geophysical’ and ‘Geophysical Plus’ potential for sugarcane and oil palm tree cultivation. Blue oval blocks represent geophysical criteria; green oval blocks represent criteria that were excluded in both, sugar cane and oil palm analysis; orange oval block represent criteria excluded only in sugar cane analysis; red rectangular blocks represent results for ‘Geophysical’ and ‘Geophysical Plus’ potential.
Figure 25: Land with ‘Geophysical potential’ for sugar cane cultivation and location of infrastructure elements (roads, ports and airports and petroleum refineries)
Figure 26: Land with ‘Geophysical potential’ (A) for oil palm tree cultivation and location of infrastructure elements (roads, ports and airports)
11.0 ANNEX 2: PERMITS, PROCESSES & REGULATIONS

Regulations relevant to establishing biofuel processing plant

A. Regulation related to Biofuel processing industries permit
Law No. 25 year 2007 on Investment. (The umbrella law for all kinds of investment in Indonesia)
Law No. 18 Year 2004 on Plantation (The Umbrella law for plantations)
Agriculture ministerial Regulation No. 26/Permentan/OT.140/2/2007 on Permit for plantation business guidelines
Presidential Instruction No. 1/ 2006 on supply and Utilization of Biofuel as alternative fuel. (Instructing related minister, governors, and bupatis to support speedy supply of biofuel as an alternative fuel).
Ministerial Regulation of MEMR no. 32 Year 2008 on procurement, utilization, and trades of Biofuel as alternative fuel. (As an Implementing Regulation ro energy law, National Energy Policy (KEN), and Presidential Instruction No. 1/ 2006 )
Ministerial Regulation of Agrarian No. 2 Year 1999 on Location Permit. (the umbrella law for all location permits)
Director General Plantation Decree no. 129.1/Kpts/HK.320/12/07 on Guideline of Technical recommendation of plantation business on investment. (Guideline to obtain the recommendation)
President Decree No. 29 Year 2004. (Regulates that foreign investment and domestic investment will be in the same office – one gate services)
President Regulation No. 90 year 2007 on Investment Coordinating Board.(The only institution that regulates investment)
Head of Investment coordinating board Decree no. 1/P/2008. (Explaining required steps)
Minister of Forestry Decree No. 146/1993 (Utilization of forest land for plantation)
President Regulation No. 77 Year 2007 juncto President Regulation No. 111 Year 2007 (contains list of business sectors which are open, open with under certain conditions, closed

B. Regulations Related to Biofuel industries
Presidential Instruction No. 1/ 2006 on supply and Utilization of Biofuel as alternative fuel. (Instructing related minister, governors, and bupatis to support speedy supply of biofuel as an alternative fuel).
Law No. 22/ 2001 on Oil and Natural Gas (The umbrella law for Oil and Gas exploration, exploitation, upstream & downstream activities, supervisions & implementation. Biofuel is considered as oil hence it may required fulfill this law).
Minister of Energy and Mineral Resources Decree No. 32/2008 on procurement, utilization, and trades of Biofuel as alternative fuel. (As an Implementing Regulation ro energy law, National Energy Policy (KEN), and Presidential Instruction No. 1/ 2006 )
Minister of Finance Decree No. 117/PMK.06/2006 on Credit for the Development of Biofuel Energy and Plantation Revitalization

➢ this decree regulated about financial credit scheme from each Bank to plasma development fund including palm oil, rubber, and cacao
Government Regulation No. 1 year 2007, about the facility of investment tax income in certain business sectors and/or in certain areas. This Government Regulation has been amended by The Government Regulation No. 62 of 2008 but does not affect biofuel.

facility of investment tax income in certain business sectors and/or in certain areas, such as: Basic organic chemical industry based on agricultural product and bioenergy industries such as: biodiesel, bio-oil, bio-ethanol dan biolube

National standard (SNI) for Biodiesel no. 04 – 7182 – 2006
National standard (SNI) for Bioethanol No. DT27 – 0001 – 2006
Director General for Oil and Gas Decree No. 13483K/24/DJM/2006 on Biodiesel specification for domestic Market.
Director General for Oil and Gas Decree No. 23204K/10 DJM/2008 on Bioethanol specification for domestic Market

C. Cost of Permit
Most of permits issued by the local government, total cost will depend on the local government where the industry will be established.
Flowchart of permit application and approval in Indonesia

**PRINCIPLE PERMIT**
- Domestic Investment application completed with article association & tax player identity number (NPWP)
- FDI application completed with Personal Identity passport

**IMPLEMENTING PERMITS ISSUED BY CAPITAL AGENCIES**
- Approval letter of Domestic Investment
- Approval letter of FDI

**IMPLEMENTING PERMITS ISSUED BY REGIONAL**
- BKPM (Investment Coordinating Board)

**PERMANENT PERMIT**
- BKPM on behalf of related

**Regional Investment Institution**
- 1. Limited Importer Identity (APIIT)
- 2. Expatriate Recruitment Plan (RPTK)
- 3. TA.01
- 4. Expatriate Recruitment Permit (IMTA)
- 5. Custom Approval for capital goods and raw material

**Other Institution**
- 1. Article of Association
- 2. Tax Payer Identity Number (NPWP)
- 3. KITAS (Temporary Stay Permit for expat)

**Permanent Product**
- BKPM on behalf of related minister
- Permanent Permit
- Commercia Product
Location Permit

Legal basis:
Ministerial Regulation of Agrarian / Kepala Badan Pertanahan Nasional No. 2 Tahun 1999 on Location Permit

Location Permit issued by regent/mayor. For DKI Jakarta, permit issued by Governor of DKI Jakarta

Requirements:
1. application letter
2. applicant identification
3. Taxpayer Identification Number (NPWP)
4. Sket lokasi yang dimohon
5. proposal
6. Governor Recomendation.

Permit of Plantation Business

Legal basis:
- Law No.18 Year 2004 On Plantation
- Agriculture Ministerial Decree No. 26/Permentan/05.140/2007 on Permit for plantation business guidelines

For any plantation cooperatives having areal of 25 Ha s.d 100.000 ha which have processing industries with capacity ≥ 5 ton TBS / jam (palm oil) and 1000 TCD (sugarcane)

Requirements:
Investor candidate submit proposal to get the IUP in written application to Governor (if the area of plantation and/or source of its raw material located across of 2 Regency/municipality or more or Regent/mayor (if the area of plantation and/or source of its raw material located within 1 regency/municipality), cc to ministry of agriculture c.q Director general Bina Produksi Perkebunan, agriculture Department.

Enclosed with following documents:
- article of association or the latest amendment;
- Taxpayer Identification Number (NPWP)
- Domicile Statement Letter;
- Recommendation about suitability according the regency master plan from Regent/Mayor (for IUP-P issued by governor)
- Recommendation about suitability according the provincial master plan from Regent/mayor (for IUP-P issued by Regent)
- Technical statement about land availability from forestry institution (if the plantation area converted from forest area) and work plan of estate cultivation.
- Location permit issued by Regent/mayor completed with location map in scale 1:100.000 or 1:50.000
- Location recommendation from local government about processing unit location.
- Statement letter about raw materials assurance from Regent/Mayor.
- Work plan of processing unit development
- Environment Impact Assessment (AMDAL), UPL,UKL
- Statement about readiness to own tools and equipment related with pest control activities.
- Statement about readiness to own tools and equipment related with land clearing without burning/fire.
- Statement about readiness to develop plantation for surrounding society according to the article 11 of Permentan 26/2007

Permit of Processing Industry Business

Legal basis:
- Law No.18 Year 2004 On Plantation
- Agriculture Ministerial Decree No. 26/Permentan/05.140/2007 on Permit for plantation business guidelines

For any processing industries business which capacity ≥ 5 ton TBS / jam (palm oil) and 1000 TCD (sugarcane)

Requirements:
To obtain the IUP – P, the written application should be send to governor or regent/mayor and enclosed with the following:
- article of association or the latest amendment;
- Taxpayer Identification Number (NPWP)
- Domicile Statement Letter;
- Recommendation about suitability according the regency master plan from Regent/Mayor (for IUP-P issued by governor)
- Recommendation about suitability according the provincial master plan from Regent/mayor (for IUP-P issued by Regent)
- Technical statement about land availability from forestry institution (if the plantation area converted from forest area) and work plan of estate cultivation.
- Location permit issued by Regent/mayor completed with location map in scale 1:100.000 or 1:50.000
- Location recommendation from local government about processing unit location.
- Statement letter about raw materials assurance from Regent/Mayor.
- Work plan of processing unit development
- Environment Impact Assessment (AMDAL)
- Statement about readiness to develop partnership.
Biofuel Commercial Business Permit

Legal basis:
Ministerial Regulation of MEMR no. 32 Year 2008 on procurement, utilization, and trades of Biofuel as alternative fuel.

Corporation submit to Minister of Energy and Mineral Resource through Director General and should be enclosed with administrative data and technical data.

Administrative Data:
- a. article of association or the latest amendment
- b. company profile
- c. Taxpayer Identification Number (NPWP)
- d. Domicile Statement Letter
- e. Company registration
- f. Statement letter with stamp duty about readiness to obey the prevail laws.
- g. Statement letter with stamp duty about readiness to conducting to inspection by the directorate general.

Technical Data:
- a. Raw Materials resources / biofuel as a alternative fuel for business
- b. Data of Biofuel Standard and quality (specification) as a alternative fuel for commerce
- c. Name and brand of biofuel as a alternative fuel for retail
- d. Feasibility business information.
- e. Statement letter with stamp duty about capability to supplying biofuel as a alternative fuel.
- f. Statement letter with stamp duty about readiness to fulfill job safety and health, also environmentally management.
## 12.0 ANNEX 3: BIOFUEL & FEEDSTOCK INSTITUTIONS AND ORGANISATIONS

### Co-operatives and Associations

#### Palm oil

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesian Palm Oil Board (IPOB)</td>
<td>Established as a key forum for better representation of the industry among key stakeholders. Publishes statistics and documentation for stakeholders. Based at the Department of Agriculture.</td>
</tr>
<tr>
<td>Indonesian Palm Oil Commission (IPOC)</td>
<td>A non-structural organization responsible to the Ministry of Agriculture with aims of enhancing the positive image of palm oil and increasing market access. It is the legal umbrella for the IPOB provides recommendations to the Ministry of Agriculture in formulating policies and regulations.</td>
</tr>
<tr>
<td>BKS – PPS <em>Badang Kerjasama Perusahaan Perkebunan Sumatera</em> [Sumatra Planters’ Association]</td>
<td>Represents employees – mainly in wage negotiations.</td>
</tr>
<tr>
<td>GAPKI <em>Gabungan Perusahaan Kelapa Sawit Indonesia</em> [Indonesian Palm Oil Producers Association]</td>
<td>Representing over 200 producers of CPO including state owned, private estates, co-operatives and smallholders. Min size of land = 200ha.</td>
</tr>
<tr>
<td>AIMMI (Indonesian Association of Cooking Oil Industries), APKASINDO (Association of Indonesian Oilpalm Farmers)</td>
<td>Represent oil palm growers.</td>
</tr>
</tbody>
</table>

#### Sugarcane

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesian Sugar Association (AGI)</td>
<td>Formed by the Government in 1981 and represents public and private sugar mills.</td>
</tr>
<tr>
<td>Indonesia Refined Sugar Association</td>
<td>Represents Sugar Refiners.</td>
</tr>
<tr>
<td>National Sugar Council (Dewan Gula Nasional)</td>
<td>Aim is to improve the efficiency and productivity of the sugar industry and improve farmers competitive position in the global marketplace. Includes government leaders from the various related ministries, farmer representatives, sugar processors, the consumer protection foundation, distributors, labor unions, as well as government and university researchers</td>
</tr>
</tbody>
</table>

#### Biofuel

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesian Biofuel Producers Association (APROBI)</td>
<td>Represents biofuel producers and has over 22 members.</td>
</tr>
<tr>
<td>Indonesian Biodiesel Forum</td>
<td>Established in 2002. It established the technical specification for biodiesel now nationally adopted.</td>
</tr>
</tbody>
</table>
13.0 ANNEX 4. MAPS OF LAND PLANNED FOR BIOFUEL FEEDSTOCK EXPANSION

The following maps have been produced by the Indonesian Government to illustrate land and climate compatibility for key biofuel crops.

**Figure 27: LAND AND CLIMATE COMPATIBILITY MAP FOR JATROPHA (Mil Ha)**

Source: Ministry of Energy and Natural Resources
Figure 28: LAND AND CLIMATE COMPATIBILITY MAP FOR PALM OIL
Figure 29: LAND AVAILABILITY FOR CASSAVA PLANTATION

Production projection 100 ton cassava per dot
Figure 30: LAND AND CLIMATE COMPATIBILITY MAP FOR SUGARCANE