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PAPUA PROVINCIAL FRAMEWORK POLICY TO PROMOTE BIOFUEL INVESTMENT

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PAPUA PROVINCIAL FRAMEWORK POLICY TO PROMOTE BIOFUEL INVESTMENT

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1.1. BACKGROUND ON PAPUA BIOFUELS

1.1.1. BRIEF PRIMER ON BIOFUELS

Biofuels are any high grade fuel produced from biological feedstocks, usually plants or their parts. The commercially most valuable ones are liquid biofuels, which include biodiesel, bioethanol, biobutanol, and others. Biogas is also a biofuel made by process of digestion, usually from animal dung. However, because it is a gas, it is useful only for local use (e.g., household cooking fuel). Therefore, the focus of both governments and industry are on the production and utilization of liquid biofuels.

Three general categories of liquid biofuels are currently possible based on existing technology. First-generation biofuels are made directly from oilseeds, grains, or sugar crops. Processes used to produce these fuels include (1) chemical processing of fats and oils from oilseeds into biodiesel and (2) biological processing of starches or sugar crops into bioethanol. Second-generation biofuels are made from trees, grasses, or agricultural residues. Biological processes are common technologies for turning the feedstock into fuels. Products include ethanol, methanol, and other fuels. Third-generation biofuels include algae for thermo-chemical processing into hydrocarbons. These are technologically less mature at present.

Of the first-generation biofuel feedstocks, those producing the highest yields are sugarcane, sugar beets, coconut and oil palm. Second-generation feedstocks are generally higher yielding but the processes are more expensive and not yet commercially available except in a few countries.

1.1.2. GLOBAL BIOFUEL MARKET

The global biofuel market is estimated to grow by double digits in the next ten years. Thus it is predicted that the global biodiesel market, which was 8.5 million ton in 2007, will reach 36.5 million ton in 2020, while the global bioethanol market, which was 44 million ton in 2007, will rise to 151 million ton in 2020.

Global production of biofuels is concentrated in the United States (43% of total), Brazil (32%) and the European Union (15%). Most production in the US and Brazil is bioethanol from maize and sugarcane, respectively, while the EU produces more than half of the world's biodiesel. All three of these producers consume most of their supply, with only 10% of the world's production being traded internationally. In Asia, India and China produce the majority of bioethanol while Indonesia and Malaysia are the top two producers of biodiesel. Together, these two countries produce 90% of the world's crude palm oil (CPO) that is the principal feedstock for biodiesel production worldwide.

1.1.3. OVERVIEW OF BIOFUELS IN INDONESIA

Research and development on biofuels began in Indonesia as early as the 1980s (fuel grade bioethanol), with biodiesel research work beginning in 1995-1997. Serious efforts to promote biofuel production and utilization in Indonesia started only in 2001. The large price

increases of crude oil in mid-2005 forced the government to reform the country's energy mix, leading to formal recognition of biofuels potential. Presidential Regulation no. 5/2006 on National Energy Policy stated, among other provisions, that biofuel utilization would be developed to contribute at least 5% to the national energy mix by 2025. Ministry of Energy and Mineral Resources estimated that this will amount to domestic consumption of about 26 million m^3/year of biofuels by 2025.

Regulation no. 5/2006 was followed by Presidential Instruction No. 1/2006 that ministers, provincial governors, and *bupati/walikota* should support and promote the establishment of a domestic biofuel industry. The Director General of Oil and Gas (as fuel authority) then issued new fuel specifications (Decrees no. 3674 and 3675 of March 17th 2006) that, among others, permit diesel fuel to contain up to 10% of fatty acids methyl ester (FAME; i.e., biodiesel) by volume and gasoline to contain up to 10% bio-ethanol by volume. This decree allowed Pertamina (the state oil and gas company) to start selling B5[1] and E5[2] in mid 2006. Biosolar, biopremium and biopertamax are Pertamina's trademarks for these products. To further push development of a domestic biofuel industry, the Minister of Energy and Mineral Resources promulgated Regulation of no 32/2008 on provision, utilization and trading of biofuel. This regulation, issued 26th September 2008, among others fixed the increasing levels of biofuel mandatory utilization up to 2025 in transportation, industry, and power generation sectors.

In January 2007, biofuels producers established the Indonesian Biofuel Producers Association (*Asosiasi Produsen Biofuel Indonesia* or APROBI). APROBI membership now consists of 11 biodiesel producers, with total production capacity of 2.5 million tons/year (~8% of domestic diesel fuel consumption), and four bioethanol producers with total production capacity of 200,000 m^3/year (~1% of domestic gasoline consumption). All existing biofuel processing plants are located in Java and Sumatra. Pertamina so far markets their biofuel blend only in Java, although the number of fuel dispensing stations (SPBUs) selling *biosolar* is continually increasing. Petroleum fuels for public and passenger transportation are sold at SPBUs at subsidized prices and similar treatment for biofuels is under discussion within and between the government and the parliament.

It is estimated that Indonesia will need 7-10 million hectares of plantation for biofuel feedstocks to meet the 2025 target, if the biofuels are produced only using first generation technologies, with about two-thirds of this total in biodiesel feedstock plantation. Palm oil is the only available biodiesel feedstock at present. Indonesia currently produces 19.5 million tons/year of CPO; 4.5 million tons/year is consumed domestically by the food industry (for cooking oil), 2.5 million tons/year are used by biodiesel processors, and the remainder is exported.

Indonesia became a net petroleum importing country in 2004 and the import/export ratio is increasing rapidly; currently Indonesia imports about 500,000 barrels/day of petroleum oil, about one-third of total domestic consumption. If properly managed, the development of a domestic biofuel industry will thus have positive effects on energy security, employment creation, equitable economic development and poverty alleviation.

[1] A mixture of 5 %-volume biodiesel and 95 %-volume petroleum diesel

[2] A mixture of 5 %-volume bioethanol and 95 %-volume gasoline

1.1.4. BRIEF HISTORY OF BIOFUEL DEVELOPMENT IN PAPUA

Papua has no biofuel plant at present, although there is an oil palm plantation which may be considered a potential supplier of biodiesel feedstock. The 7,700 ha plantation located in District Arso, Kabupaten Keerom is managed by PT Perkebunan Nusantara (PTPN) II, a state-owned enterprise based in Medan, North Sumatra. The plantation operates a nucleus-plasma production scheme with a 2,300 ha nucleus plantation. Compared to sister plantations in Sumatra, however, the Arso plantation is less productive. It produces only 7.7-12.2 tons/hectare/year of oil palm fresh fruit bunches (FFB), whereas well-managed oil palm plantations in Java and Sumatera could reach 16-20 tons/hectare annual productivity.

The Arso plantation has a palm oil mill with a capacity of 60 tons/hour FFB. The CPO quality produced by the mill frequently does not meet industry standards, however, with 9% free fatty acid (FFA) and 0.4% moisture content whereas the commercial standards require a maximum 5% FFA and maximum 0.2% moisture. Because there is no cooking oil plant factory in Papua, the CPO is shipped to other islands (Java and Sumatra). This CPO deteriorates further in storage tanks due to shipping delays. Higher FFA or moisture content in fatty oil makes processing the oil into biodiesel both more difficult and costly.

In addition to oil palm, the private company PT Emerald Planet is starting to cultivate *jarak pagar* (*Jatropha curcas*) in Biak and Sentani, in cooperation with local people. Total planted area is still small, expected to reach 240 hectares by August 2009, although company management have stated that they plan to establish a crude jatropha oil plant with a capacity of 10,000 tons/year by 2011.

1.2. BACKGROUND ON POLICY PROCESS

1.2.1. GOVERNOR INITIATED

This framework policy for biofuel investment was initiated by Papua Provincial Governor Bp. Barnabas Suebu, S.H. Gov. Suebu recognized the opportunity of increased investment in the green energy sector as a way to scale up broad economic activity in Papua for the benefit of all of the Province's people.

With that recognition, Gov. Suebu determined that a participatory, iterative process would be needed to guide the growth of biofuel production and processing in Papua. The quantity and quality of available data prevent complete development of a detailed policy at this time. Therefore, this framework policy describes the outlines of what the province would like to achieve while also indicating where additional information and consultation will provide better detail going forward.

1.2.2. HIGHLIGHTS OF PARTICIPATORY PROCESS

The process used by the Provincial Government in developing this framework policy has been to engage key stakeholders in preliminary fact-finding to obtain information necessary in formulating policy recommendations to the Province. Mechanisms used in undertaking this fact-finding include workshops, consultations, and review of published reports from academic, scientific and advocacy organizations on relevant topics.

Representatives of government departments, private sector associations, nongovernmental organizations, and other stakeholder groups have participated in consultations and workshops. Technical and academic reports and publications from provincial, national, and international institutions provided secondary data useful for understanding the dynamics of the context for this framework policy. Local government and people's organizations – along with each of the stakeholders listed above – will be invited to comment on this draft and to offer suggestions for improvement toward a final provincial policy and implementation.

2. PROVINCIAL BIOFUEL POLICY GOALS AND OBJECTIVES

2.1. GOAL OF POLICY FOR BIOFUEL INVESTMENT

2.1.1. OVERALL BIOFUEL POLICY GOAL

The goal of the framework policy is to define in broad terms ways that the provincial government will promote the growth of a green energy industry in Papua.

The framework policy recognizes and supports the provincial policies on sustainable forest management and people-centered development.

The framework policy also recognizes and adheres to national policies, legislation, and regulation related to the energy industry, forests and land use, socioeconomic development, and investment promotion.

2.1.2. PURPOSES OF BIOFUEL POLICY

The purpose of the Papua Provincial Framework Policy to Promote Biofuel Investment is to encourage investments that meet the twin goals of:

(1) Economic and social development for the benefit of Papuans, and
(2) Conservation and sustainable stewardship of the Province's natural resource capital base.

Within these two broad goals, the governor's office identified three specific purposes for promoting biofuel investment in Papua. These are:

(1) Catalyst for Development – the biofuel or green energy sector has the potential to encourage comprehensive economic development in the province. The effects of this comprehensive development may include the following:
    a. Generating direct and indirect employment for Papuans,
    b. Increasing the farm-level income of large numbers of Papuans producing biofuel feedstocks, and
    c. Stimulating general economic growth from increased business transactions with money circulating within Papua.
(2) Capitalize on Market Demand – the national and global markets for biofuels are projected to experience rapid growth in the next decades. This market demand is part of the broad worldwide transformation from economies based on fossil fuel energy to more sustainable energy sources for transport and power generation. Papua can position itself now to be a major provider of biofuels to meet this increased local, national, regional and global demand.
(3) Generate Investment Revenue – as the green energy sector expands, the revenue base of the Province will also grow in a way that complements existing economic

activity in mining, forestry and agriculture. A larger revenue base for the Province will provide more budgetary resources for the provincial government to invest in improvements to communications, transport, power, and other infrastructure that forms the foundation of a diversified and dynamic economy.

2.2. OBJECTIVES OF BIOFUEL POLICY

2.2.1. SUSTAINABLE LAND USE

Papua Province issued a policy on sustainable forest management in 2008. This policy stated – among other provisions – that some areas classified by Ministry of Forestry as conversion forest may be allocated for use to produce feedstocks for biofuel production in the province.

The province holds 6.4 million hectares of conversion forest. Most of this forest is thought to still be in primary condition, making it the home of important biodiversity and other environmental services. Large portions of this conversion forest land are far removed from infrastructure, making harvest and transport of products uneconomical. Much of this land also falls under *adat* use rights. Sustainable use of Papua's land must consider ecological, economic, and social factors in making rational, logical planning decisions.

Therefore, in formulating policies and regulations governing the use of land in the province, the objective of those policies must be that the land use is sustainable. The land use must contribute to meeting the needs of today's generation of Papuans – socially, economically, spiritually, and ecologically – without reducing the ability of the land to provide the same set of products and services to future generations.

2.2.2. SUSTAINABLE ECONOMIC GROWTH

As noted above, growth of investment in the green energy sector can be a catalyst for comprehensive economic development in the province. By contributing to a solid foundation of long-term benefits for the province, biofuel production and processing helps build a diversified economy that is not reliant on a single commodity or company for a disproportionate share of the Gross Regional Domestic Product.

Previous experience with plantation crops in Papua has not been completely successful. Some of the oil palm plantations established in the 1980s have much lower productivity and profitability than their sister plantations in other parts of Indonesia. Smallholder producers' are even less productive than the state-owned plantations, according to international researchers.

In order for biofuel production and processing to provide the catalytic effect on overall development that is one of its purposes then it must be founded on sound business and economic principles rather than speculative investments. The objective will be to achieve long-term employment opportunities for the people of Papua while also increasing farmer incomes from the production of biofuel feedstocks. These jobs and higher levels of farmer income will provide a general increase in business transactions by keeping money flowing throughout the economy of Papua. Raw material export is not a sustainable economy.

2.2.3. SUSTAINABLE PROVISION OF FOOD AND FUEL

One of the criticisms of the biofuel industry globally and nationally is the diversion of food supplies toward biofuel feedstocks. This detrimental effect is often cited as an argument against biomass-based fuel production. Advocacy groups, the fossil fuel industries, and others produce reports that higher food costs are a direct result of using food supplies for biofuel.

What most of these reports and arguments usually do not discuss is the potential for dual-use feedstocks, for example where bagasse from sugar processing or other waste products from food processing can form the feedstock for a second product of bioethanol.

The objective in this framework policy to promote biofuel investments in Papua is to encourage the use of (1) single-use feedstocks that do not have a food supply use, to reduce competition between uses; and (2) dual-use of those feedstocks that do have usefulness as both fuel and food. This means maximizing the secondary processing of waste from food production as feedstock for fuel production.

2.2.4. SUSTAINABLE SOCIAL COHESION

Another negative effect of past biofuel production efforts in Papua has been the dispossession of traditional communities of their *adat* ownership. When the state, or private companies operating under license from the state, removes people from their traditional lands, the investments produce high social costs. Likewise, if expanded production leads to the migration of large numbers of workers for biofuel expansion from other parts of the country, social tensions about jobs can be created.

To avoid these social costs, some producers or processors have instead focused on the conversion of ecologically sensitive lands with lower populations such as peat forests and freshwater swamps. These environmental costs also have the potential to increase rather than decrease social costs in the long term.

The provincial policy for promotion of biofuel investment has the objective of requiring that all investors respect formally and informally recognized *hak ulayat*, *masyarakat adat*, and related sets of customary rights of Papuans, as is also required in the *Otsus* and existing provincial policies.

3. BIOFUEL INVESTMENT FOR SUSTAINABLE LAND USE

3.1. PAPUA'S FOREST LANDS

3.1.1. ECOLOGY OF PAPUA FORESTS

Ecologists estimate that 84% of the land area of Papua is forested. Several forest cover types are well represented, including lowland rainforests, swamp forests, montane forests, and mangrove forests. Papua has the third largest intact expanse of lowland tropical rainforest in the world, and the largest in Asia (about 148,223 km2). **Error! Reference source not found.** shows the approximate area of each forest type, based on data from the World Bank, and the Ministry of Forestry, Conservation International, and Forest Watch Indonesia.

Table 1: Forest cover types in Papua

Forest cover type	Area (km^2)	% of total forest	% of total land
Lowland evergreen rainforest	148,223	52.42	47.10
Swamp, swamp brush and swamp forest	65,487	23.16	20.81
Montane rainforest and subalpine forest	38,750	13.70	12.31
Mangrove forest	10,656	3.77	3.39
Brush and savanna	16,967	6.00	5.39
Plantation forest and estate crops	2,673	0.95	0.85
Total forest cover (incl. savanna & plantations)	***282,756***	***100.00%***	***89.85%***
Cultivated lands, including aquaculture	8,071	n/a	2.56
Mining, settlements, transmigration and other	23,890	n/a	7.59
Total land area	**314,715**		**100%**

Sources: adapted from (1) Marshall, AJ. 2006. The Diversity and Conservation of Papua's Ecosystems. Chap. 5.1 in Marshall, AJ and Beehler BM (eds.). 2006. The Ecology of Papua. *Singapore: Periplus Editions; and (2) World Bank. 2008. A Strategic Assessment of Spatial Planning Options for Papua Province.*

The high Central Cordillera of Papua, averaging more than 3,000 meters above sea level, forms a spine in the middle of the province. It provides a large number of deep valleys, many with unique combinations of soils, slopes, rainfall and other factors leading to high diversity of plant and animal life.

To the south is a broad plain of alluvial soils that give rise to one of the largest freshwater wetlands and mangrove ecosystems in the world. The swamp and mangrove forests (almost 84,000 km^2) sit on deep peat soils, with savanna and grasslands in the Transfly of the southeastern corner of the province.

The north-facing slopes of the Central Cordillera drain into the large Mamberamo Basin, then between the Foja Mountains and Van Rees Mountains to a northern plain along the coast.

With this diversity of topography, soil types, and relatively high rainfall (2.5-5.5 meters annually), Papua has global significance as an area of wilderness biodiversity. The peat soils and primary forests also hold one of the largest areas in the world of carbon storage.

3.1.2. CURRENT STATE OF PAPUA FORESTS

During the New Order government, the Ministry of Forestry classified Papua's forests according to the national classification system. These include, among others, production forests (*hutan produksi*), conservation forests (*hutan lindung*), and forests allocated for conversion (*hutan conversi*). **Error! Reference source not found.** provides the most recent assessment of areas within each of these classifications.

Table 2: Classification of forest lands in Papua

Forest classification	Area (km^2)	Area (hectares)
Protection forest (*Kawasan Suaka Alam*)	56,377.59	5,637,758.59
Conservation forest (*Hutan Lindung*)	82,189.77	8,218,976.50
Production forest (*Hutan Produksi*)	80,733.15	8,073,314.98
Limited production forest (*Hutan Produksi Terbatas*)	17,959.47	1,795,947.41
Conversion forest (*Hutan Konversi*)	63,661.96	6,366,195.74
Total	**300,921.94**	**30,092,193.22**

Sources: BAPPEDA Papua and USAID Environmental Services Program.

The total area classified as forest is less than the total area forested shown in **Error! Reference source not found.** due to some of the Conversion Forest being no longer forested. Most of that difference is now under cultivation.

The provincial government has allocated up to 4.5 million hectares as potentially available for production of biofuel feedstocks. All of this area is classified as Conversion Forest. Yet, the province also has made up to 5 million hectares potentially available for carbon storage schemes under the proposed Reduced Emissions from Deforestation and Forest Degradation (REDD) scheme being negotiated under the United Nations Framework Convention on Climate Change (UNFCCC), discussed further below.

Clearly, these two commitments cannot both be honored fully because the province contains only 6.4 million hectares of land classified as Conversion Forest and some of this land is already being cultivated.

3.2. LAND-RELATED ISSUES AND CHALLENGES FOR BIOFUEL INVESTMENT IN PAPUA

3.2.1. BIODIVERSITY

Papua enjoys one of the most diverse natural heritages in a country known internationally as one of the most bio-diverse in the world. From snow-capped mountains to vibrant coral reefs, the province has a many species found nowhere else. This heritage is part of the birthright of every Papuan now and in the future.

Biodiversity matters in Papua, as elsewhere, for several reasons. One is the "existence value" of many of the species. The world is a poorer place when we lose many of species that make it both intellectually interesting and spiritually comforting. There are also practical reasons for biodiversity to be conserved. Many medicines originate from forest plants. Forest-based birds and insects are necessary to pollinate many fruit and nut crops that are important for food and economic trade. Finally, forests and other areas that have healthy, diverse ecosystems can generate jobs and income from nature-based tourism.

Commercial-scale production of biofuel feedstocks has the potential to reduce this biodiversity. Research studies have shown that oil palm plantations, for example, have much lower diversity of mammals, birds, butterflies, and plants compared to natural forests.

The issue and challenge for increased biofuel investment in Papua is how to achieve growth of this green energy sector without the cost of reduced diversity of plants and animals and ecosystems. Closely linked to this challenge is the issue of plantation concessionaires who use harvests of primary forest timber as the capital for establishing their plantations, which sometimes do not materialize after the forest is cut.

3.2.2. CARBON

Payment for carbon storage from avoided deforestation

Recent years have seen considerable interest among international environmental organizations in ways to use payments from the global carbon markets to provide income to communities and countries to protect healthy primary forests. The UNFCCC Conference of Parties has been conducting negotiations to develop a mechanism for these types of payments.

Following the Bali Roadmap agreed at the Conference of Parties in 2007, negotiations are expected to conclude at the 2009 Conference of Parties in Copenhagen. Much work has been accomplished on ways to make transfer payments from developed to developing countries for REDD under the post-2012 phase of the Kyoto Protocol.

Currently, no mechanism officially exists for these payments. Instead, the voluntary carbon markets are viewed as being able to finance forest preservation based on the amount of carbon in the forests. Using date from recent estimates, the forests of Papua in theory could produce income of more than Rp1,000 trillion from carbon markets. This estimate uses an average price of about Rp541,640[3] per ton of carbon dioxide equivalent (CO_2e), and 5 million hectares pledged for carbon storage use in Papua.

Current price on the voluntary market, however, is Rp9,088 per ton CO_2e (7 July 2009), meaning that instead of Rp1,000 trillion (US$110 billion), the province could only get Rp18.2 trillion (US$2 billion), while having signed its land rights over to foreign investors as a conditionality of the transactions with international financiers. To put this figure into perspective, PT Freeport paid $1.1 billion in taxes to the Indonesian government in 2006. Rather than the estimate of 100 years worth of PT Freeport taxes (a portion of which is allocated to Papua), carbon is worth less at current prices than two years of payments from the largest tax payer in the province.

[3] Adapted from compliance market prices cited in Butler, RA, LP Koh, and J Ghazoul. 2009. REDD in the red: palm oil could undermine carbon payment schemes. *Conservation Letters*. Published online 21 Jan 2009. www3.interscience.wiley.com/journal.

Carbon Pay-Back Period

Biofuel use is growing internationally because of the search for energy sources other than fossil fuels that are one of the primary contributors to greenhouse gas emissions. Another biofuel issue related to carbon, therefore, is whether the alternatives to fossil fuels do provide a positive net balance compared to fossil fuels. Usually, what is important to consider is how quickly the emissions from clearing land in order to plant biofuel feedstocks are compensated through reduced used of fossil fuels and carbon sequestered from the atmosphere by the growing biofuel feedstock.

The standard measure of this is the carbon pay-back period: the number of years it takes for the balance of carbon emissions reduced + carbon sequestered to be less than the carbon emitted from land clearing. Research from throughout the ASEAN region published in 2009 shows that if oil palm, coconut, or sugarcane are grown on croplands, degraded lands, or grasslands they can pay off their carbon debt in one or two years. If, however, those same biofuel feedstocks are grown on forestland that has been cleared, it could take hundreds of years to pay back the carbon. Converting forests – even degraded forests – to oil palm production does not make sense from the perspective of reducing greenhouse gas emissions.

3.2.3. PEAT SOILS

Papua has an estimated 6.9 million hectares of peat soils, primarily in Asmat, Mappi, Merauke, Mimika, and Sarmi districts. Peat soils present a complicated set of issues for expanded biofuel production. On the one hand, these lands are typically less populated than other parts of the province. This means that the availability of land for commercial-scale plantations of biofuel feedstocks is higher relative to other areas. For this reason, some investors are attracted to peat soil areas due to lower social costs involved in establishing and operating plantations.

The environmental costs of clearing land on peat soils, however, are much higher. With an average depth of around 2 meters, and by definition their very high levels of organic matter, these soils are extraordinary in terms of carbon storage. Using estimates from the World Bank of 6.9 million hectares of peat soils in Papua x average depth of 2 meters x estimated amount of carbon per hectare, Papua's peat soils could contain as much as 8.28 billion tons of carbon or more than 28 billion tons CO_2e.

Using a conservative estimate of 8 tons per year of carbon emissions from exposed peat soils, this works out to 38 million tons CO_2e emitted annually if just 20% of Papua's peat soils were to be exposed as part of converting the lands to oil palm or other plantation crops. The carbon pay-back period for peat soils converted to biofuel production is estimated to be in the range of 1,000 to 10,000 years.

Although some recent news reports have claimed that Indonesia is the third-largest emitter of greenhouse gases in the world (after China and the United States), reputable international rankings place Indonesia at #22 in 2007, a slight decline from 2004. Deforestation is the largest cause of the country's emissions.

3.2.4. WATERSHEDS AND OTHER ENVIRONMENTAL SERVICES

Another land use issue related to promoting biofuel investments is that of watersheds. The Mamberamo Basin, for example, is a huge watershed (8 million hectares) draining north-facing slopes of the Central Cordillera. Consisting of freshwater swamps, extensive sago groves, and very deep peat soils, it harbors a substantial portion of Papua's biodiversity. The

river also provides important hydrological services for an estimated 25% of the total area of Papua province and both resident and migratory birds. Sparsely populated compared to other parts of the province, Mamberamo is potentially attractive for biofuel feedstock plantation expansion. As with the peat soil areas of Papua, however, the environmental costs of converting Mamberamo into feedstock plantations may exceed the benefits. Also, the business case for locating in this relatively isolated part of the province may be unsound, since transport costs of raw material or processed biodiesel or bioethanol may exceed the market value of the fuel.

Kabupaten Merauke also is an important area for watershed considerations. The rapidly growing urban town of Merauke depends on the Rawa Biru swamp in Wasur National Park for its water supply. This large wetland is important biodiversity habitat for fish and bird species in addition to its value as critical watershed for Merauke. Altering the hydrology of the swamps in Merauke district by expanding oil palm plantations is again likely to lead to greater environmental and social costs than the economic benefits.

3.3. POLICY RESPONSE TO ENCOURAGE SUSTAINABLE LAND USE FOR BIOFUEL INVESTMENT

Careful consideration of the context, ecology, and other issues related to land use lead to the following policy provisions:

Table 3: Policy on sustainable land use for biofuel investment

Policy part A: Sustainable land use	Rationale / justification	Related provision(s)
(1) Investments in increased production of feedstock biomass for processing into biofuel shall be permitted only on lands designated for such use by relevant provincial authorities.	Provincial government has the duty, authority and responsibility to regulate land use by issuing permits in line with national laws and policies.	#s (30), (31), (32)
(2) In order to reduce damage to the diverse biological heritage of Papua province, no plantation shall be established on land covered by natural forest as of 1st July 2009.	Research shows that converting natural forest to plantations negatively affects biodiversity, carbon storage, and hydrology.	
(3) Natural forest under Provision #(2) shall include primary and secondary forests, whether the secondary growth arose from unassisted (natural) regeneration, assisted natural regeneration (e.g., enrichment planting), or plantation establishment or replanting.	Converting secondary forest for oil palm or other plantation crops also negatively affects biodiversity, carbon storage, and hydrology.	#(2)
(4) Provision #(2) shall also apply to degraded forest.	Same as above.	#(2)

Policy part A: Sustainable land use	Rationale / justification	Related provision(s)
(5) In order to avoid increased carbon emissions from oxidation of below-ground biomass, no clearing of land classified by competent authorities as Histosols (peat soils) shall be permitted.	The carbon and hydrology dynamics of peat soils are especially vulnerable to exposure, requiring as much as thousands of years to recover carbon emissions through sequestration by planted species.	
(6) In order to encourage investments in expanded production of biofuel feedstocks, plantation permits may be issued for non-food croplands, grasslands, or marginal lands as of 1st July 2009.	Papua seeks to support growth of the industry in a well-regulated manner that avoids or limits any harmful environmental and social impacts. These land uses generally meet that objective.	#s (30), (31), (32)
(7) The classification of croplands, grasslands, or marginal lands shall have been made by competent authorities using standard methodologies for land cover classification.	Only competent authorities have the duty and responsibility to classify land, land cover, and designate land uses.	
(8) In order to protect and conserve the unique ecosystem of the Mamberamo Basin, no plantation for biofuel feedstock larger than 3,000 hectares shall be permitted within the Basin.	The Mamberamo Basin swamp forests and other ecosystem attributes are especially fragile and require specific protection mechanisms. A limit of 3,000 ha provides local government a tool for more closely monitoring and mitigating impacts.	
(9) In order to obtain a permit for the establishment of biofuel feedstock plantings, the applicant shall first have demonstrated full compliance with all applicable provincial, national and international laws, regulations, and conventions regarding environmental and social impacts.	The act of issuing a land-use permit before legal requirements are met is a violation of these laws.	#s (30), (31), (32)
(10) Investment will not significantly interrupt or degrade watershed services. To establish this is so, the *Forum Pengelolaan Daerah Aliran Sungai* (Forum for Watershed Management) will be informed.	Many parts of Papua are designated for watershed protection, especially in the highlands. These areas are required by law to be able to maintain their ecosystem service functions. The Forum is the designated management authority.	

4. BIOFUEL INVESTMENT FOR SUSTAINABLE ECONOMIC GROWTH

4.1. PAPUA'S ECONOMY

4.1.1. BRIEF OVERVIEW OF THE ECONOMY OF PAPUA

Papua province is estimated to have a gross regional domestic product (GRDP) of Rp22.24 trillion (US$2.4 billion) in 2005. By far the largest segment of the economy (Rp14.4 trillion; 64.5% of total) is the mining sector. Agriculture employs the largest number of people (75% of total workforce), contributing 14% to GRDP (Rp3.1 trillion). Table 4 shows the breakdown of Papua's economy by major sector.

Table 4: Economy of Papua (gross regional domestic product) in recent years

Economic sector	2001	2002	2003	2004	2005	5-year avg.	% of total (avg.)
Mining & quarrying	13,890.75	14,418.56	13,917.67	8,871.76	14,349.10	13,089.57	65.02
Agriculture & forestry	2,625.33	2,804.84	2,939.90	2,921.79	3,087.21	2,875.81	14.28
Financial & other services	1,212.65	1,308.04	1,347.18	1,421.59	1,464.07	1,350.71	6.71
Construction & industries	1,051.88	1,140.97	1,221.11	1,305.40	1,386.79	1,221.23	6.07
Trade, hotels, restaurants	730.57	801.92	873.07	943.45	1,020.81	873.96	4.34
Transport & utilities	535.35	604.60	720.49	818.98	929.46	721.78	3.59
TOTAL	**22,047.53**	**23,080.93**	**23,022.42**	**18,286.97**	**24,242.44**	**20,133.06**	**100.00**

Note: All figures reported in billions of Rupiah
Source: Adapted from World Bank. 2008. A Strategic Assessment of Spatial Planning Options for Papua Province.

Being capital-intensive, the mining sector does not contribute substantially in terms of employment for Papuans. Many of the employees, especially in skilled and semi-skilled jobs, are migrants from other parts of Indonesia. One recent estimate said that about 300,000 people have migrated to Papua under official transmigration programs of the Indonesian government, and that spontaneous migration has led to more than 400,000 arriving outside of the formal program. This means that of an estimated two million people living in Papua, only about two-thirds are indigenous.

Historically, the estate crops and forestry sub-sectors also have used labor from other islands rather than Papuans. While the reasons for this situation are complex, and have changed somewhat over time, the result has been tensions between indigenous Papuans and migrants. Per capita GDP in Papua is among the highest in the country, but the wealth is concentrated in urban areas such as Jayapura. Rural Papuans are the poorest in all of Indonesia, partly due to limited access to education and employment opportunity.

4.1.2. CURRENT TRENDS IN PAPUAN ECONOMY

The economy of Papua is growing, yet not very robustly (cf. Table 4). The province remains dependent on a single industry, dominated by a single company, for a large portion of overall GRDP. The net result of this is that when the mining sector – and specifically PT Freeport – does well, Papua's economy does well. Conversely, when the sector (and company) does not have a good year, neither does the province.

Transport and communications experienced an average 15% annual growth between 2001 and 2005, from a fairly small base of just over 500 million rupiah to almost 900 million. Over the same period, the trade, construction, and business services (including financial services) sectors all experienced nearly annual gains of more than 8%. Yet overall the economy grew 7.5%, with increases in these sectors offset by relatively slow year-on-year growth in the mining sector (including a 36% decline in 2004 compared to 2003). Agriculture, forestry and estate crops – the 2nd-largest sector in the provincial economy – also experienced rather slow average annual growth of only 4%.

Recent updates from the FCO have shown that the public sector is growing in terms of both absolute size and as a proportion of the overall provincial economy. Also, exports are growing strongly. The challenge for this is that those exports are raw materials rather than finished or semi-processed goods. The provincial government of Papua hopes to invest heavily in coming years in the transport, energy and communications infrastructure in order to stimulate broader growth of a more diversified economy.

4.2. ECONOMIC ISSUES AND CHALLENGES FOR BIOFUEL INVESTMENT IN PAPUA

4.2.1. GLOBAL RECESSION

The world economy is undergoing a period of sharp reduction in growth. Effects of this include limited availability of investment capital in some markets, volatile prices for oil and other commodities, and a general aversion to higher risk exposure. Many planned large-scale investments have been postponed, cancelled, or downsized. The biofuel industry has felt these effects, along with other economic sectors.

For Papua, this challenge may be an opportunity. Some of the more optimistic assessments in recent years about the scope, scale, growth, and profitability of the biofuel industry (as well as carbon storage from REDD) are now undergoing reassessment, with more sobering results. Business and economic cycles are not an infrequent occurrence, with Indonesia undergoing a period of severe contraction in 1997-1998. The more realistic expectations coming from revised analyses may provide a buffer in future times of lower growth while also allowing investors to realize higher returns during times of favorable business and economic performance.

4.2.2. SECTOR TRENDS

Global production of biofuels has increased 500% over the past decade. The trend has not been steady, however, as a year-on-year basis. A 2009 Asia regional report characterized the world markets as "boom and bust", with some of the same volatility seen in global petroleum markets. For example, in 2002, prices for CPO were higher than those for crude

oil. This encouraged expansion in the industry. By 2005, world prices favored crude oil and by 2007, processors were closing plants rather than investing in expansion. Malaysia recently estimated its industry to be operating at 16% of capacity.

Indonesia is not immune to this volatility. As the world's largest producer of CPO for both cooking oil and biofuel use, the domestic industry has risen and fallen with the global market prices. One of the ways that the national government is trying to stabilize the industry – and the domestic price of cooking oil – is to put in place a set of policies, regulations and incentives. This national policy framework includes:

a) National Energy Policy (President Regulation No. 5/2006) – mandating that biofuels comprise at least 5% of the total national energy mix by 2025;
b) Biofuel Acceleration Program (President Instruction No. 1/2006);
c) National Biofuel Development Team (President Decree No. 10/2006);
d) Biofuel Standards – established by Pertamina and PLN; and
e) Indonesia Energy Act (No. 30/2007) – and the implementing regulation no. 32/2009

4.2.3. SMALLHOLDER PRODUCTION SCHEMES

Provincial policy in Papua is to proactively increase the proportion of economic activity accessible by average Papuans. This official focus on affirmative action for Papua means that business and investment opportunities, as well as employment, need to be conducted in a manner that does not favor larger and often more sophisticated investors and employers from outside of the province. In the forestry sector, as an example, provincial policy supports community-based forest management so that local businesses can participate, and encourage more local employment through decentralized forest management.

For the biofuel industry, this policy also means that labor-intensive production systems are preferred. Productivity among smallholder oil palm producers is lower than it is for state-owned producers such as PT Perkebunan Nusantara (PTPN). The system of nucleus-plasma operations – where farmers transfer some land tenure rights to the "nucleus" company in exchange for participation as "plasma" smallholder growers in surrounding lands – has unrealized potential. These schemes have been problematic because of companies not providing adequate technical support, or requiring smallholder participants to become indebted for initial plantation establishment costs, or negotiating inequitable price contracts. When the companies and smallholders both operate in good faith, with fairness for both parties, then a nucleus-plasma scheme can be beneficial for both parties and the broader economy.

For this reason, local government has a strong interest in monitoring (1) the amount and quality of technical support that companies provide to smallholders supplying them with raw material, (2) the levels and terms of debt that smallholders may incur as part of their participation in the scheme, (3) the terms and conditions of contracts between processors and smallholders and mechanisms for compliance by both parties, and (4) the formal and informal mechanisms established between the parties for preventing, mitigating, and resolving any disputes that may arise during the conduct of their business together.

4.2.4. HUMAN RESOURCES AND INSTITUTIONAL CAPACITIES

The depth and breadth of skills sets within Papua that might establish and operate a vibrant biofuel industry in the province are limited. Large commercial operations in other sectors, such as mining, have resolved this issue in their industries by encouraging the migration of skilled and semi-skilled labor from other provinces. This situation has created social tensions and in some cases conflict that is self-reinforcing. As marginalized local populations

react to perceptions of unequal opportunity, migrants decrease their level of interaction, in some instances leading to "enclave" lifestyles that create further distance between the two groups and heighten the mistrust and incomplete understanding of each other.

The curricula in Papua's schools also are limited in terms of being able to develop a skilled and semi-skilled pool of labor that can contribute to long-term employment opportunities for Papuans. Few corporate operators requiring skilled and semi-skilled labor have the resources or ability to provide technical trade schools of their own. Therefore, as part of its support and encouragement to the growth of the industry, it is in the interests of the government to provide mechanisms for trade skills to be acquired by as much of the local population as is practical.

4.3. POLICY RESPONSE TO ENCOURAGE BIOFUEL INVESTMENT FOR SUSTAINABLE ECONOMIC GROWTH

Given the policy objective of sustainable economic growth, the current and expected future business and economic potential for investment in the province, and the issues discussed above, the following policy provisions shall apply in Papua:

Table 5: Policy on biofuel investment for sustainable economic growth

Policy part B: Sustainable economic growth	Rationale / justification	Related provision(s)
(11) In order to encourage responsible investment in the biofuel industry in Papua, the provincial and other levels of government shall explore in detail different options for providing incentives.	This general policy cannot take all stakeholder viewpoints into consideration. More consultation at kabupaten level would be needed to identify specific incentives and disincentives.	
(12) The options named in Provision #(11) may include tax incentives, capital finance incentives, streamlined processing of permit processes within the legal requirements for all permits, or other incentive as may be identified by the government, legislature, private sector, or other stakeholders.	Same as above.	#(11)
(13) Capital finance incentives as described in Provision #(12) may include credit guarantees, favorable loan terms, or other legal forms of capital finance incentive permissible for the applicant.	Some examples of possible financial incentives.	#(12)
(14) Potential biofuel investors shall demonstrate compliance with national and local regulations, laws, and policies relative to biofuels and obtain and retain all relevant Business Permits.	In addition to other relevant and applicable laws or regulations, this provision refers to Ministry of Energy and Mineral Resources regulation No. 32 year 2008, regarding Supply, Utilization and Trading Procedure of Biofuel as Alternate Fuel.	

Policy part B: Sustainable economic growth	Rationale / justification	Related provision(s)
(15) In order to enhance the participation of the local business community in the development of a robust biofuel industry in Papua, any investor from outside of the province will identify and provide a meaningful role for qualified members of the existing business community in Papua.	Historically, local business people have not been able to participate in government schemes that favored investors from other provinces or even other countries. The Province seeks to alter this by providing local business people the opportunity to participate in growth of the biofuel industry.	
(16) The provincial government may detail in one or more Special Regional Regulation (*Perdasus*) or Provincial Special Regulation (*Perdasi*) specific definitions and guidelines for "local business", "meaningful role" or other aspects of Provision #(15) in accordance with the *Otsus*.	The precise legal meaning of terms such as "meaningful role" cannot be proscribed in a general policy such as this. Additional consultation with local business and with potential investors is needed to identify regulatory provisions necessary to implement this policy objective.	#(15)
(17) Biofuel investors are encouraged to develop nucleus-plasma production schemes that enhance participation of local community members as meaningful partners.	Experience in other parts of Indonesia has shown that this is a viable business model that meets both objectives of this policy: returns to investors on their capital and risk, and returns to the people of Papua on their land and labor.	#s (30), (31), (32)
(18) Local participation as described in Provision #(17) shall be undertaken in good faith by all parties and governed by formal and binding agreements related to land use, financing, technical support, quality standards, sales and pricing, dispute resolution, and other relevant aspects of the business relationship.	Historical experience has been mixed regarding the implementation of nucleus-plasma schemes. The Province seeks to provide the means for redressing these issues without discouraging investment.	#s (17), (30), (31), (32)
(19) Negotiation and implementation of agreements entered into as described in Provision #(18) shall be monitored by relevant agencies of provincial or other levels of government as necessary.	It is in the interest of the government to monitor that business agreements are equitable so that social costs of unfair practices can be minimized.	#s (18), (30), (31), (32)
(20) When the results of government monitoring described in Provision #(19) indicate additional action is required, the government may issue and implement additional regulations that specify more detailed requirements for Agreements as described in Provision #(18).	If voluntary adherence to this policy is not made, then the government must proactively regulate agreements for optimal benefit to society.	#s (18), (19), (30), (31), (32)
(21) In order that technical, skilled and semi-skilled employment opportunities in the biofuel industry may be made available to the local population, the provincial or other appropriate levels of the government may support the design, development, and implementation of vocational training or other skills acquisition mechanisms as necessary to optimize local workforce qualifications.	Papuans have fewer opportunities for these jobs because of less access to skills acquisition. If the province is to build a sustainable industry, there must be increased and improved skills building. Few countries or regions have thrived over the long term using primarily imported skills.	# (17)

5. BIOFUEL INVESTMENT FOR SUSTAINABLE FOOD AND FUEL

5.1. BIOFUEL FEEDSTOCKS IN AND FOR PAPUA

5.1.1. FIRST AND SECOND GENERATION BIOFUELS

First generation biofuels are those produced and marketed by the present day biofuel industry. First generation biodiesel is also called FAME (fatty acids methyl ester) biodiesel. It is made from fats or fatty oils (either edible or non-edible) by a process called transesterification. First generation bioethanol is the ethanol made from sugary or starchy raw materials by biotechnological processes such as saccharification and fermentation.

Second generation biofuels are made from non-edible plant parts generally designated or classified as ligno-cellulose and include wood, straw, bagasse, sago cortex, grasses, empty fruit bunches of oil palm and coconut, and other sources. Second generation biodiesel is a hydrocarbon diesel fuel made from ligno-cellulose via thermal-catalytic processes, whereas second generation bioethanol is made from ligno-cellulose via pretreatment + saccharification + fermentation.

5.1.2. POTENTIAL FEEDSTOCKS FOR BIOFUEL PRODUCTION IN PAPUA

Within Papua, there are a number of possible feedstocks that could be processed into biodiesel. A common characteristic is that each contains either fats or fatty oils that have properties indicating their possible use. More detailed examination of the actual quantity and quality of oil production potential is needed for these to be commercially viable feedstocks in the industry.

First generation biodiesel

Possible biodiesel feedstocks include:

1) For lowland regions of Papua except forested lands and peat soil areas:
    a. Edible oil crops:
        i. Oil palm (*Elaeis guineensis*)
        ii. Coconut (*Cocos nucifera*)
        iii. Horseradish (*Moringa oleifera*)
    b. Nonedible oil crops :
        i. Pongam (*Pongamia pinnata*)
        ii. Alexandrian laurel (*Calophyllum inophyllum*)
        iii. Neem (*Azadirachta indica*)

iv. Physic nut (*Jatropha curcas*)
v. Kapok (*Ceiba pentandra*)

2) For highland region of central Papua (e.g., Baliem Valley, possibly other parts of Kab. Jayawijaya, Paniai, Puncak Jaya, Peunungan Bintang, Tolikara, and Yahukimo):
   a. Native plants:
      i. Buah merah (*Pandanus conoideus*)
      ii. Kelapa hutan (*Pandanus julianettii*)
   b. Non-native plants:
      i. Sunflower (*Helianthus annuus*)
      ii. Canola or rapeseed (*Brassica napus*)

Canola is the oilseed crop used for making biodiesel in Canada and Europe (known as rapeseed there). All of those listed are edible oil crops. For "buah merah" and "kelapa hutan", much research remains to be done to obtain information on productivity per hectare, low-cost method of oil extraction, characteristics of biodiesel made from the oils, etc. Table 6 provides some additional information on these oil crops.

Table 6: Potential oil crops for biodiesel manufacture in Papua

Name			Source of oil	Oil content, % dry basis	Edible/ non-edible
Botanical name	**English**	**Indonesia / Papua**			
Elaeis guineensis	Oil palm	Sawit	Pericarp, kernel	45-70, 46-54	E
Cocos nucifera	Coconut	Kelapa	Kernel	60 – 70	E
Pongamia pinnata	Pongam	Mabai/Mbau*)	Seed	27 – 39	NE
Calophyllum inophyllum	Alexandrian laurel	Bintangur (nyamplung)	Seed kernel	40 – 73	NE
Azadirachta indica	Neem	Nimba/Mimba	Seed kernel	40 – 60	NE
Moringa oleifera	Horseradish	Kelor	Seed kernel	30 – 49	E
Ceiba pentandra	Kapok	Kapok/randu	Seed kernel		
Jatropha curcas	Physic nut	Jarak pagar	Seed kernel	40 – 60	NE
Pandanus conoideus	Red pandan	Buah merah	Fruit, pericarp	15 – 36?	E
Pandanus julianettii	Karuka nut	Kelapa hutan	Kernel	51?	E
Helianthus annuus	Sunflower	Bunga matahari	Seed kernel	32 – 50	E
Brassica napus	Rapeseed/canola	Kanola	Seed	30 – 45	E

*) *Mbau is the name of pongam in Kabupaten Mimika (Amongme and Komoro Tribes)*

First generation bioethanol

1) For lowland regions:
   a. Food producing:
      i. Sago (*Metroxylon sagu*)
      ii. Sugarcane (*Saccharum officinarum*)
      iii. Sweet potato (*Ipomoea batatas*)
      iv. Cassava (*Manihot esculenta*)
   b. Non-food producing:
      i. Nypa (*Nypa frutican*)
      ii. Sweet sorghum (*Sorghum bicolor*)

2) For highland regions:
   a. Food producing:
      i. Sweet potato (*Ipomoea batatas*),
      ii. Maize/Corn (*Zea mays*)
      iii. Sugar beet (*Beta vulgaris*)

Table 7 shows potential ethanol yields from these sugar and starch crops.

Table 7: Potential bioethanol yield from possible feedstocks for use in Papua

Crop name			Harvest yield, ton/ha/yr	Bioethanol yield	
Botanical name	English	Indonesia/Papua		Liter/ton	Liter/ha/yr
Metroxylon sago	Sago	Sagu	6.8[$)1)]	608	4,133
Ipomoea batatas	Sweet potato	Batatas/hipere	62.5[&]	125	7,812
Manihot esculenta	Cassava	Singkong	25	180	4,500
Nypa frutican	Nypa	Nipah	27	93	2,500
Sorghum bicolor	Sweet sorghum	Sorgum manis	80[#]	75	6,000
Saccharum officinarum	Sugarcane	Tebu	75	67	5,025
-	Molasses[*)]	Tetes	3.6	270	973

[$)] Dry sago starch, [&] 2½ harvests/year, [#]2 harvests/year.
[*)] Molasses is the side product of sugar manufacture from cane.
[1)] There exists possibility for direct processing of ground sago pith into bioethanol, i.e. without prior extraction of the sago starch, which quite probably will be more cost effective. However, only information on bioconversion of (extracted) sago starch into ethanol is found in the literature.

Multipurpose bioenergy crops/resources

The 2nd generation biofuel technologies (which may achieve commercial viability by 2015) will enable industry to utilize lingo-cellulosic biomass as a non-edible raw material for manufacturing biofuels. Together with established 1st generation biofuel technologies that could utilize surplus edible feedstocks (sugar, starch, fatty oils), these 2nd generation feedstocks would allow production of biofuels (principally biodiesel and bioethanol) to be mutually supporting with the production/provision of food.

Further to this encouraging development, however, we should also recognize that the increasing scarcity and price of crude oil, plus the increasing awareness of environmental protection, will lead to a growing demand of not only biofuel, but also other plant-based (or bio-based) products that presently compete less favorably with petrochemicals. Among these are natural elastomer, natural fibers, natural medicines and herbal products, biofertilizer, and biopesticide. Therefore, in order to minimize land requirement, the future choices of energy crops should focus on multipurpose energy crops. These are crops that allow the production of biofuels to be mutually supporting with the production/provision of either food or other important bio-based products. Some examples of multipurpose energy crops are given in Table 8.

Table 8: Some identified multipurpose energy crops with potential biofuel feedstock use in Papua

Botanical name	English name	Indonesian name	Characteristics
Elaeis guineensis	Oil palm	Sawit	(a), (b)
Cocos nucifera	Coconut	Kelapa	(a), (b)
Metroxylon sago	Sago	Sagu	(a), (b)
Saccharum officinarum	Sugarcane	Tebu	(a), (b)
Sorghum bicolor	Sweet sorghum	Sorgum manis	(a), (b)
Zea mays	Corn	Jagung	(a), (b)
Moringa oleifera	Horseradish	Kelor	(a), (c), (h)
Cajanus cajan	Pigeon pea	Kacang hiris	(a), (c)
Artocarpus altilis	Breadfruit	Sukun	(a), (c)
Pongamia pinnata	Pongam, karanj	Mabai/Mbau	(c), (d), (e), (h), (i)
Azadirachta indica	Neem	Nimba/Mimba	(c), (d), (e), (h), (i)
Calophyllum inophyllum	Alexandrian laurel	Bintangur/nyamplung	(d), (e), (i)
Hevea brasiliensis	Rubber tree	Karet	(d), (f)
Palaquium gutta	Gutta-percha	Getah perca	(d), (f)
Ceiba pentandra	Kapok	Kapok/randu	(d), (g)

(a) produces foodstuffs; (b) produces large quantity of harvest-residue biomass; (c) fast growing (firewood crop or short-rotation coppice); (d) produces non-edible oil;

(e) produces bioactive chemicals; (f) produces latex; (g) produces fibers; (h) nitrogen-fixing; (i) can withstand salty/sea water.

Single-use second generation feedstocks

Among the category of fast growing trees, the fastest growing ones are those trees that produce only lingo-cellulosic biomass; i.e., yield practically no sugar, starch, oil, protein, latex or bioactive chemical. These plants thus are useful to be grown only for provision of feedstocks for second generation biofuels and may be considered less desirable than multipurpose bio-energy crops/resources. Examples include "turi" (*Sesbania grandiflora*), "janti/jayanti" (*Sesbania sesban*), Calliandra (*Calliandra calothyrsus*), "sengon/albasiah" (*Albizia chinensis, A. falcata, A. lebbek*), "akasia" (*Acacia* spp.), and "cemara' (*Casuarina equisetifolia, C. junghuhniana*).

5.2. FEEDSTOCK-RELATED ISSUES AND CHALLENGES FOR BIOFUEL INVESTMENT IN PAPUA

5.2.1. FOOD VS. FUEL?

One of the most vocal criticisms of the biofuel industry globally has been that its expansion is coming at the expense of food security, especially for the poor. While there may have been some links between the growth of biofuels and rising commodity prices in the past few years, the debate is not entirely valid. One of the main developments within the industry, as described above, has been the shift from 1st generation to 2nd or 3rd generation feedstocks.

For example, use of maize or soya as a primary feedstock not only contributes to the food vs. fuel trade-off, it is actually less efficient fuel production. Within Papua, the discussions have centered on a few potential feedstocks: cassava, sweet potato, and sago. The first two of these are poor sources of biofuel in terms of productivity per hectare, and the quality of fuel produced. Other feedstocks can produce the same amount of fuel more efficiently both financially and in terms of land productivity.

In the case of sago, there are valid reasons for concern. It is capable of producing a high quality fuel at relatively efficient conversion rates. Yet sago is an important staple food for many Papuans. It is also a plant that requires complete harvest of the growing stem, leading to increased risk of environmental costs ranging from collateral damage to other species or increased peripheral deforestation from building access roads, to altered hydrology of the freshwater swamps and their important carbon and biodiversity values. Fortunately, the use of sago does not have to be a trade-off of food vs. fuel use.

5.2.2. BOTH FOOD AND FUEL

One of the potential advantages of sago is that the waste produced from processing the food starch can become a 2nd generation feedstock for bioethanol production. All other factors being equal, sago has the possibility of providing both food and fuel. The challenge for this to happen is that starch processing for food is most often done at household level, meaning the waste is very highly decentralized. This is not the case with bagasse from sugarcane processing, for example, where the processing of sugar that produces the waste stream is by necessity already relatively centralized.

Some have suggested that increasing the area planted to sago is one way to address this issue, where the trees are grown in industrial plantations, with starch and fuel production both centralized at or near the plantations. Although this may have some merit, a full environmental and social impact assessment along with financial analysis would be necessary before issuing land-use permits for sago plantations. One issue with this type of scheme would be whether those households relying on sago as their staple food would have the cash resources to purchase processed sago starch to feed their families. It is not likely.

Among the other feedstocks mentioned above, *nipah* palm (*Nypa fruticans*) is one that has multiple uses. Its leaves are valued for roofing material, weaving curios, and household implements such as brooms. The sap is used commercially to make vinegar, fermented to make an alcoholic drink, and is a potentially sustainable source of bioethanol. *Nipah* has no trunk; instead, it has a large underground rootstock that continues to produce large, fan-like leaves. Fruiting stems are tapped for the sap that can be converted to bioethanol. Because *nipah* occurs along brackish watercourses, access does not require road construction into or through environmentally fragile areas.

5.2.3. TRANSPORT OF FEEDSTOCKS TO PLANTS

Papua has only 5,100 kilometers of good road, and 10,300 kilometers of poor road. In a province of more than 300,000 km^2, this is one of the lowest areas of transport access in Indonesia. Only 14% of the land is within 10 km of a road. That inevitably increases the cost of transport, thereby increasing the cost of moving goods. Cement in Wamena, for example, costs 7-8 times as much as in Jayapura due to the Rp10,000 per kilo cost of air shipment.

There may be substantial practical barriers to overcome for households realistically to be expected to transport sago or other agricultural waste to a processing facility. What would be needed is a price paid for this waste that significantly exceeds the cost of transport to the processing facility. Full feasibility analyses would be needed to assess the business prospects of a highly decentralized feedstock (e.g., sago waste) and relatively centralized oil production facilities.

A possible means to address this issue might be the introduction of small, more widely dispersed facilities for initial extraction of bioethanol from the agricultural residues such as sago waste. The product of that process would then need to undergo further processing to achieve quality standards to make it marketable as a biofuel product. Again, the financial aspects of this would need to be assessed in greater detail.

5.2.4. TECHNICAL CHALLENGES AND OPPORTUNITIES FOR PROCESSING

Questions also arise about the technology for processing agricultural residues into usable biofuels. An additional set of questions remain unanswered about the business sense of this type of production system in Papua, given the remoteness and relative inaccessibility of most parts of the Province. One specific area where these factors come to the forefront is in the highland kabupaten of Jayawijaya, Paniai, Puncak Jaya, Peunungan Bintang, Tolikara, and Yahukimo.

The highlands present both a challenge and an opportunity for biofuel industry development. Challenges include the lack of transport, a fragmented landscape, high ethno-linguistic diversity, and perhaps most important for biofuels: the limited number of suitable feedstocks

due to the elevation, topography, and rainfall all being higher than other parts of the province. Opportunities in the highlands include favorable local market conditions (transport fuels cost at least four times as much compared to prices in Jayapura), a number of potential multi-product feedstocks, and a relatively higher proportion of smallholder farmers with agroforestry fields which can be used to grow feedstocks. This latter aspect also supports getting local people involved in the industry as discussed above (cf. Sustainable Economic Growth).

Recent fieldwork in the highlands identified at least three potential feedstocks that are worthy of further study to determine commercial suitability. Two of these – sunflower and rapeseed – are unknown crops to most highland farmers. Both can, however, be used to produce cooking oil as well as biofuels. [As a comparison, one liter of cooking oil in Wamena costs Rp20,000 vs. Rp12,000 in Jayapura.] Increasing the local production of *minyak goreng* in the highlands could have immediate and direct benefits for a large number of households.

The third potential feedstock identified is *Pandanus conoideus*, known as Red Pandan (*Buah Merah*). This monocot is widely grown by highland farmers, especially in Kab. Tolikara, for medicinal purposes. It is very high in beta carotene in addition to having 36% raw oil content in its fruiting body. The closely-related *P. julianetti* (known as *Kelapa Hutan*) is reported to have 52% oil in its seed kernel, but does not have the dual purpose of producing both fuel and medicine. It is eaten in Papua New Guinea.

5.3. POLICY RESPONSE TO ENCOURAGE SUSTAINABLE FEEDSTOCKS FOR BIOFUEL INVESTMENT

Given the policy objective of sustainable feedstocks, the current and expected future feedstock potential for biofuel investment in the province, and the issues discussed above, the following policy provisions shall apply in Papua:

Table 9: Policy on sustainable feedstocks for biofuel investment

Policy part C: Sustainable economic growth	Rationale / justification	Related provision(s)
(22) In order to encourage growth of the biofuel industry in Papua without negatively affecting the food security of the human population, the provincial and other levels of government shall favor processors and operators utilizing one or more of the following: a. Multi-purpose bio-energy sources that provide fuel and other useful products (food, medicine, etc.), b. Non-food first-generation feedstocks, c. Second-generation feedstocks.	Favoring multi-purpose, non-food, and second-generation feedstocks for biofuel production alleviates the competition between food and fuel markets for the same raw material.	

Policy part C: Sustainable economic growth	Rationale / justification	Related provision(s)
(23) Relevant qualified institutions or organizations should undertake research on various aspects of the biofuel industry, including but not limited to one or more of the following: a. Comparative productivity of different feedstocks under different conditions in Papua; b. Methods for increasing or optimizing productivity of the most promising feedstocks; c. Business models that optimize profitability to growers, processors, and investors; d. Social and cultural factors affecting the growth of the industry and ways to integrate existing socio-cultural systems into viable business operations; e. Land and resource tenure administration systems and their effects on business viability; f. Technologies for conversion of feedstocks into biofuels and their dissemination; g. Vocational and technical skills training needs and mechanisms for their provision; h. Other aspects of the biofuel industry in Papua as indicated by interested stakeholders.	A large number of questions related to the long-term viability of a biofuel industry do not yet have answers. By encouraging the beginnings of research programs at the early stages of the industry's development, growth may be both accelerated and more sustainable.	#s (17), (21), (22), (30), (31), (32)
(24) In order to specifically target highland areas of Papua, where poverty rates are high and business opportunities relatively low, the Provincial or Kabupaten governments may support the design, development, and implementation of projects or programs for biofuel investment in these areas.	The highland areas of Papua are historically underserved by government services and business opportunities. It is in the government's interest to take proactive steps to begin correcting this situation.	# (23)
(25) The programs described under Provision #(24) may include, *inter alia*, conducting feasibility studies, market analyses, field trials, pilot projects, or other activities that support testing the viability of biofuel production and processing in the highland kabupaten.	There are many more questions related to the production and processing of biofuels in the highlands. Experimentation may be the best way to answer these questions. For example, *buah merah* and *hipere* (sweet potato) are potential local feedstocks that should be explored further.	#s (23), (24)
(26) Research and Development programs described under Provisions #(23) and #(25) may be funded by government, private sector, international donor, or nongovernmental organizations with strong interest in promoting a sustainable biofuel industry in the Province.	Malaysia developed its world class production and processing capabilities on the strength of early investments in ongoing research efforts to make continual improvement part of the industry.	#s (23), (25)

Policy part C: Sustainable economic growth	Rationale / justification	Related provision(s)
(27) Potential investors who present viable business plans that utilize integrated production and processing in the highlands of cooking oil, biofuel, and other useful products may receive additional incentives to be specified in *Perdasus* or *Perdasi*.	Local government may, after seeing the results of research, decide that additional incentives are needed to further encourage investors in the highlands.	# (24)
(28) If research results show promising potential in the highlands for biofuel feedstocks that are not familiar to farmers, then government extension programs should support dissemination and promotion of these crops to farmers.	Sunflower (*Mata Hari*) and rapeseed [for canola], for example, are unknown crops that may require sponsored efforts to increase farmers' knowledge and success in producing these feedstocks. The same is not the case with *Buah Merah*.	#s (23), (24)

6. BIOFUEL INVESTMENT AND SUSTAINABLE SOCIAL COHESION

6.1. PAPUA'S ETHNIC DIVERSITY AND ITS LEGAL PROTECTIONS

6.1.1. PEOPLES OF PAPUA

Papua Province is estimated to have a population of about 2 million people, making it the least densely populated province in Indonesia. With more than 300,000 km^2 of land area, Papua has a population density of only about 6.3 persons per square kilometer, equivalent to the density of Kazakhstan. Jawa Barat is almost 200 times as densely populated. Papua's population growth rate is estimated at 3%, the highest in the country. Some of the growth is due to migration from other provinces.

The ethno-linguistic diversity of Papua is among the highest in the world. Eleven major ethnicities speak as many as 269 different languages. This presents both a challenge and an opportunity. With such high diversity of ethnic identification, formulating policies and programs that incorporate these cultural distinctions can be difficult. For those who make the effort, however, the differences can increase realization of the national motto: Unity in Diversity (*Bhinneka Tunggal Ika*).

Intra-clan relationships are generally strong and guide social interaction and conflict resolution systems. Among the different ethnic groups, some are patrilineal and others matrilineal. These differences in the inheritance structure can have effects on land and resource tenure (see below). There are also several different types of political systems, ranging from those based on leadership by achievement to those based on inherited leadership. Each of the points along this continuum may have slightly different ways to resolve intra-group and inter-group conflicts. Understanding the specific system in a given area is a necessary part of being able to successfully negotiate and implement business relationships for investors.

6.1.2. MASYARAKAT ADAT, HAK ULAYAT, AND MAJELIS RAKYAT

One of the relatively unique aspects of Papua compared to other provinces of Indonesia is the *Otonomi Khusus* (commonly called *Otsus*; Law No. 21 year 2001 on Special Autonomy for Papua Province). This law gives Papua specific legal rights and responsibilities over all matters which are not specifically retained by central government.

Among the provisions of the *Otsus* are those relating to the establishment of the Papuan Community Parliament (*Majelis Rakyat Papua* or MRP). The MRP was created through Government Regulation No. 54/2004. Two of the duties of the MRP that are relevant for the biofuel industry are "receiving opinions, aspirations and complaints of the people" (Chap. IX, Part 5, Section 40) and "considering the protection of the rights of native Papuans"

(Chap. IX, Part 6, Section 41). This latter provision requires that regional policy formulated by provincial or district governments must receive consideration by the MRP, and that the MRP will provide its conclusions to the district government within 14 days. A similar consent clause applies to *Perdasus* promulgated by the provincial legislature.

Perhaps the most important provision of Regulation 54/2004 from the perspective of potential biofuel investors is that "MRP has the power and responsibility to … give suggestions, consideration and agree upon work contracts and tenders for work made between the government and provincial government and third parties to operate in the province, in particular those which concern the protection of the rights of native Papuans.[4]" This effective veto power over provincial and district contracts or tenders means that any investor must participate in protecting the rights of native Papuans if they expect to do business in the province.

6.2. SOCIAL ISSUES AND CHALLENGES FOR BIOFUEL INVESTMENT IN PAPUA

6.2.1. LAND TENURE

It has been observed that nearly every square meter of land in Papua is claimed by someone. Seldom are these rights formalized. Most are *adat* rights under traditional land administration. Conflicting claims within and among the traditional peoples are usually settled through the *Hak Ulayat* system, which is recognized in *Otsus* Chapter XI, Article 43(4). The *Otsus* also reintroduced a customary court, *peradilan adat*, for civil or criminal cases involving members of customary communities.

Land allocations by central government in the New Order era did not always respect these traditional forms of land tenure. Dispossession was not uncommon. As an example, the PTPN oil palm plantation in the Arso area of Kab. Keerom is reported to have been "assigned" to the state-owned entity under duress. This sometimes took the form of pistols aimed at a landowner's son. With this recent historical memory, it is no surprise that many farmers remain unenthusiastic about growing oil palm 30 years later.

6.2.2. RESOURCE TENURE

Resource tenure under traditional *adat* systems has been less well documented. There is some evidence that crop fields, trees, and other resource access rights have both spatial and temporal dynamics. In terms of expanding the biofuel industry, this is an important consideration because there may be situations where the land and the trees on the land have different owners. Negotiating land and resource access agreements must recognize these factors and be as inclusive of all legitimate stakeholders as is necessary.

6.2.3. *ADAT* RIGHTS AND LAND ADMINISTRATION

The biggest challenge for encouraging greater integration of indigenous Papuans into economic growth activities in the province is that traditional mechanisms of land

[4] Quoted from unofficial translation of Regulation 54/2004 by Jennifer Robinson. Final version of this policy document in Indonesian should quote from actual text of the Regulation.

administration do not facilitate people being able to collateralize their land. Lacking formal documentation, landowners are unable to use titles as collateral in obtaining access to loan financing, for example.
The absence of formal documentation also effectively prevents using land as an equity contribution in joint ventures with investors. This inability to participate in transactions that are common in the formal economy further exacerbates the marginalization of indigenous Papuans.

6.2.4. GOVERNMENT SYSTEM FOR LAND ADMINISTRATION

The government land administration system, by contrast, is relatively formalized. Titles, leases, and concession agreements are widely used to grant access to land. The challenge is that transparency has not always been as strong as it could be in many of these transactions. Outright dispossession of traditional landowners, as noted above, has been at times coercive in the past.

6.3. POLICY RESPONSE TO ENCOURAGE SUSTAINABLE SOCIAL COHESION IN BIOFUEL INVESTMENT

Given the policy objective of sustainable social cohesion, the current and expected future potential for biofuel investment in the province, and the issues discussed above, the following policy provisions shall apply in Papua:

Table 10: Policy on sustainable social cohesion in biofuel investment

Policy part D: Sustainable economic growth	Rationale / justification	Related provision(s)
(29) In order to encourage growth of the biofuel industry in Papua without creating negative social costs, the provincial and other levels of government will prefer business owners and operators with long-term presence in Papua.	Established businesses in Papua are more likely to understand and respect the socio-cultural aspects of doing business in the province.	# (15)
(30) All applications for land to be used for producing or processing biofuels and their feedstocks shall have the prior informed consent of recognized holders of government or *adat* rights to the land	Legal provisions and principles for industry best practice require that prior informed consent be given before anyone's land use rights can be reduced or removed.	#s (1), (6), (9), (17), (18), (19), (20), (23), (31), (32)
(31) Any land use involving reduced rights for land owners shall include adequate compensation for the land owner, whether the owners' rights are recognized through government or adat systems	In keeping with international conventions, and national and local laws, people cannot be dispossessed of their land without adequate compensation.	#s (1), (6), (9), (17), (18), (19), (20), (23), (30), (32)
(32) The process of negotiating land use access by all biofuel producers or processors must be conducted in a transparent manner and be fully documented.	Transparent negotiation that is fully documented protects both parties in the event of any later dispute about the terms and conditions of an agreement.	#s (1), (6), (9), (17), (18), (19), (20), (23), (30), (31)

7. SUMMARY OF PAPUA PROVINCIAL POLICY FOR BIOFUEL INVESTMENT

Policy part A: Sustainable land use	Rationale / justification	Related provision(s)
1. Investments in increased production of feedstock biomass for processing into biofuel shall be permitted only on lands designated for such use by relevant provincial authorities.	Provincial government has the duty, authority and responsibility to regulate land use by issuing permits in line with national laws and policies.	#s 30,31, 32
2. In order to reduce damage to the diverse biological heritage of Papua province, no plantation shall be established on land covered by natural forest as of 1st July 2009.	Research shows that converting natural forest to plantations negatively affects biodiversity, carbon storage, and hydrology.	
3. Natural forest under Provision #(2) shall include primary and secondary forests, whether the secondary growth arose from unassisted (natural) regeneration, assisted natural regeneration (e.g., enrichment planting), or plantation establishment or replanting.	Converting secondary forest for oil palm or other plantation crops also negatively affects biodiversity, carbon storage, and hydrology.	#(2)
4. Provision #(2) shall also apply to degraded forest.	Same as above.	#(2)
5. In order to avoid increased carbon emissions from oxidation of below-ground biomass, no clearing of land classified by competent authorities as Histosols (peat soils) shall be permitted.	The carbon and hydrology dynamics of peat soils are especially vulnerable to exposure, requiring as much as thousands of years to recover carbon emissions through sequestration by planted species.	
6. In order to encourage investments in expanded production of biofuel feedstocks, plantation permits may be issued for non-food croplands, grasslands, or marginal lands as of 1st July 2009.	Papua seeks to support growth of the industry in a well-regulated manner that avoids or limits any harmful environmental and social impacts. These land uses generally meet that objective.	#s 30,31, 32
7. The classification of croplands, grasslands, or marginal lands shall have been made by competent authorities using standard methodologies for land cover classification.	Only competent authorities have the duty and responsibility to classify land, land cover, and designate land uses.	
8. In order to protect and conserve the unique ecosystem of the Mamberamo Basin, no plantation for biofuel feedstock larger than 3,000 hectares shall be permitted within the Basin.	The Mamberamo Basin swamp forests and other ecosystem attributes are especially fragile and require specific protection mechanisms.	

9. In order to obtain a permit for the establishment of biofuel feedstock plantings, the applicant shall first have demonstrated full compliance with all applicable provincial, national and international laws, regulations, and conventions regarding environmental and social impacts.	The act of issuing a land-use permit before legal requirements are met is a violation of these laws.	#s 30,31, 32
10. Investment will not significantly interrupt or degrade watershed services. To establish this is so, the *Forum Pengelolaan Daerah Aliran Sungai* (Forum for Watershed Management) will be informed.	Many parts of Papua are designated for watershed protection, especially in the highlands. These areas are required by law to be able to maintain their ecosystem service functions. The Forum is the designated management authority.	
Policy part B: Sustainable economic growth	**Rationale / justification**	**Related provision(s)**
11. In order to encourage responsible investment in the biofuel industry in Papua, the provincial and other levels of government shall explore in detail different options for providing incentives.	This general policy cannot take all stakeholder viewpoints into consideration. More consultation at kabupaten level would be needed to identify specific incentives and disincentives.	
12. The options named in Provision #(11) may include tax incentives, capital finance incentives, streamlined processing of permit processes within the legal requirements for all permits, or other incentive as may be identified by the government, legislature, private sector, or other stakeholders.	Same as above.	#(11)
13. Capital finance incentives as described in Provision #(12) may include credit guarantees, favorable loan terms, or other legal forms of capital finance incentive permissible for the applicant.	Some examples of possible financial incentives.	#(12)
14. Potential biofuel investors shall demonstrate compliance with national and local regulations, laws, and policies relative to biofuels and obtain and retain all relevant Business Permits.	In addition to other relevant and applicable laws or regulations, this provision refers to Ministry of Energy and Mineral Resources regulation No. 32 year 2008, regarding Supply, Utilization and Trading Procedure of Biofuel as Alternate Fuel.	
15. In order to enhance the participation of the local business community in the development of a robust biofuel industry in Papua, any investor from outside of the province will identify and provide a meaningful role for qualified members of the existing business community in Papua.	Historically, local business people have not been able to participate in government schemes that favored investors from other provinces or even other countries. The Province seeks to alter this by providing local business people the opportunity to participate in growth of the biofuel industry.	
16. The provincial government may detail in one or more Special Regional Regulation (*Perdasus*) or Provincial Special Regulation (*Perdasi*) specific definitions and guidelines for "local business", "meaningful role" or other aspects of Provision #(15) in accordance with the *Otsus*.	The precise legal meaning of terms such as "meaningful role" cannot be proscribed in a general policy such as this. Additional consultation with local business and with potential investors is needed to identify regulatory provisions necessary to implement this policy objective.	#(15)

17. Biofuel investors are encouraged to develop nucleus-plasma production schemes that enhance participation of local community members as meaningful partners.	Experience in other parts of Indonesia has shown that this is a viable business model that meets both objectives of this policy: returns to investors on their capital and risk, and returns to the people of Papua on their land and labor.	#s 30,31, 32
18. Local participation as described in Provision #(17) shall be undertaken in good faith by all parties and governed by formal and binding agreements related to land use, financing, technical support, quality standards, sales and pricing, dispute resolution, and other relevant aspects of the business relationship.	Historical experience has been mixed regarding the implementation of nucleus-plasma schemes. The Province seeks to provide the means for redressing these issues without discouraging investment.	#s (17), 30,31, 32
19. Negotiation and implementation of agreements entered into as described in Provision #(18) shall be monitored by relevant agencies of provincial or other levels of government as necessary.	It is in the interest of the government to monitor that business agreements are equitable so that social costs of unfair practices can be minimized.	#s (18), 30,31, 32
20. When the results of government monitoring described in Provision #(19) indicate additional action is required, the government may issue and implement additional regulations that specify more detailed requirements for Agreements as described in Provision #(18).	If voluntary adherence to this policy is not made, then the government must proactively regulate agreements for optimal benefit to society.	#s (18), (19), 30,31, 32
21. In order that technical, skilled and semi-skilled employment opportunities in the biofuel industry may be made available to the local population, the provincial or other appropriate levels of the government may support the design, development, and implementation of vocational training or other skills acquisition mechanisms as necessary to optimize local workforce qualifications.	Papuans have fewer opportunities for these jobs because of less access to skills acquisition. If the province is to build a sustainable industry, there must be increased and improved skills building. Few countries or regions have thrived over the long term using primarily imported skills.	#17
Policy part C: Sustainable feedstocks	**Rationale / justification**	**Related provision(s)**
22. In order to encourage growth of the biofuel industry in Papua without negatively affecting the food security of the human population, the provincial and other levels of government shall favor processors and operators utilizing one or more of the following: a. Multi-purpose bio-energy sources that provide fuel and other useful products (food, medicine, etc.), b. Non-food first-generation feedstocks, c. Second-generation feedstocks.	Favoring multi-purpose, non-food, and second-generation feedstocks for biofuel production alleviates the competition between food and fuel markets for the same raw material.	

23. Relevant qualified institutions or organizations should undertake research on various aspects of the biofuel industry, including but not limited to one or more of the following: a. Comparative productivity of different feedstocks under different conditions in Papua; b. Methods for increasing or optimizing productivity of the most promising feedstocks; c. Business models that optimize profitability to growers, processors, and investors; d. Social and cultural factors affecting the growth of the industry and ways to integrate existing socio-cultural systems into viable business operations; e. Land and resource tenure administration systems and their effects on business viability; f. Technologies for conversion of feedstocks into biofuels and their dissemination; g. Vocational and technical skills training needs and mechanisms for their provision; h. Other aspects of the biofuel industry in Papua as indicated by interested stakeholders.	A large number of questions related to the long-term viability of a biofuel industry do not yet have answers. By encouraging the beginnings of research programs at the early stages of the industry's development, growth may be both accelerated and more sustainable.	#s 17, 21,22, 30,31, 32
24. In order to specifically target highland areas of Papua, where poverty rates are high and business opportunities relatively low, the Provincial or Kabupaten governments may support the design, development, and implementation of projects or programs for biofuel investment in these areas.	The highland areas of Papua are historically underserved by government services and business opportunities. It is in the government's interest to take proactive steps to begin correcting this situation.	# 23
25. The programs described under Provision #(24) may include, inter alia, conducting feasibility studies, market analyses, field trials, pilot projects, or other activities that support testing the viability of biofuel production and processing in the highland kabupaten.	There are many more questions related to the production and processing of biofuels in the highlands. Experimentation may be the best way to answer these questions. For example, *buah merah* and *hipere* (sweet potato) are potential local feedstocks that should be explored further.	#s 23, 24
26. Research and development programs described under Provisions #(23) and #25 may be funded by government, private sector, international donor, or nongovernmental organizations with strong interest in promoting a sustainable biofuel industry in the Province.	Malaysia developed its world class production and processing capabilities on the strength of early investments in ongoing research efforts to make continual improvement part of the industry.	#s 23, 25

27. Potential investors who present viable business plans that utilize integrated production and processing in the highlands of cooking oil, biofuel, and other useful products may receive additional incentives to be specified in *Perdasus* or *Perdasi*.	Local government may, after seeing the results of research, decide that additional incentives are needed to further encourage investors in the highlands.	# 24
28. If research results show promising potential in the highlands for biofuel feedstocks that are not familiar to farmers, then government extension programs should support dissemination and promotion of these crops to farmers.	Sunflower (*Mata Hari*) and rapeseed [for canola], for example, are unknown crops that may require sponsored efforts to increase farmers' knowledge and success in producing these feedstocks. The same is not the case with *Buah Merah*.	#s 23, 24
Policy part D: Sustainable social cohesion	**Rationale / justification**	**Related provision(s)**
29. In order to encourage growth of the biofuel industry in Papua without creating negative social costs, the provincial and other levels of government will prefer business owners and operators with long-term presence in Papua.	Established businesses in Papua are more likely to understand and respect the socio-cultural aspects of doing business in the province.	# 15
30. All applications for land to be used for producing or processing biofuels and their feedstocks shall have the prior informed consent of recognized holders of government or *adat* rights to the land	Legal provisions and principles for industry best practice require that prior informed consent be given before anyone's land use rights can be reduced or removed.	#s 1, 6, 9, 17, 18, 19, 20, 23, 31, 32
31. Any land use involving reduced rights for land owners shall include adequate compensation for the land owner, whether the owners' rights are recognized through government or *adat* systems	In keeping with international conventions, and national and local laws, people cannot be dispossessed of their land without adequate compensation.	#s 1, 6, 9, 17, 18, 19, 20, 23, 30, 32
32. The process of negotiating land use access by all biofuel producers or processors must be conducted in a transparent manner and be fully documented.	Transparent negotiation that is fully documented protects both parties in the event of any later dispute about the terms and conditions of an agreement.	#s 1, 6, 9, 17, 18, 19, 20, 23, 30, 31

8. APPENDIX

8.1. REPORT ON TRIPS AND SELECTED MEETINGS

A. TRIP TO ARSO OIL PALM PLANTATION OF PTPN II IN KABUPATEN KEEROM

Observations

Total area of plantation in 2009 is 7,687 hectares (ha) and consists of 2,287 ha Nucleus (*Inti*), 3,600 ha Plasma (*PIR*), 1,800 ha KKPA (*Kredit Koperasi untuk Petani Anggota*). Many parts of the plantation look more like oil palm forest than oil palm plantation; i.e., they are less well-managed compared to their sister plantations in other parts of Indonesia. Although the type and condition of the soil and the agro-climate are considered suitable for oil palm cultivation, the fresh fruit bunch (FFB) productivity of the plantation has been continually decreasing from 12.2 ton/ha in 2004 to 7.7 ton/ha in 2008 (FFB productivity in other parts of Indonesia is normally 16 – 20 ton/ha.

The Arso plantation has a palm oil mill with a capacity of 60 ton/hour FFB. The mill normally reaches a good yield of palm oil extraction (20 % of FB). Kernel is not processed in Papua; rather is sold/shipped to North Sumatra or *Bitung* (North Sulawesi). Due to several factors (e.g., delivery time of FFB to the mill is frequently more than 24 hours), the quality of crude palm oil (CPO) produced by the mill is frequently unsatisfactory. For example, it contains 9% free fatty acid (FFA) and 0.4% moisture whereas the commercial standard requirements are for a maximum 5% FFA and maximum 0.2% moisture. The CPO is shipped to other islands (Java, Sumatra) because as yet there is no cooking oil factory in Papua (the minimum economic size of a cooking oil factory is 200 ton/day). Due to shipping delay, the CPO may further deteriorate in storage tanks.

Recommendations

Plantation nurturing habit should be revitalized and improved. Compliance to the Standard Operating Procedures (SOPs) of oil palm plantation and palm oil mill managements should be attempted and then well maintained.

Note : Even if the CPO is to be processed into biodiesel in Papua, the quality has to meet the general standard of CPO. Biodiesel processing cost increases rapidly as the FFA and moisture contents of the raw material rise above the standard requirements.

B. MEETING WITH KADIN (CHAMBER OF COMMERCE AND INDUSTRY) OF PAPUA

Observations

KADIN welcomes the initiative of the provincial government to formulate the general policy of biofuel investment in Papua. KADIN has the opinion that, for businessmen with long experience in Papua, land use negotiation with native Papuan is not very difficult (or insurmountable). KADIN hopes that the policy standings and viewpoints of various

government bodies in Papua (governor's office, BAPPEDA, *Dinas-dinas*, etc) are well harmonized and united.

Recommendation
More regular and intense meetings among academics, businessmen, and government to exchange thoughts and opinions should be carried out to improve understanding.

C. TRIP TO WAMENA

Observations
Fuel supply situation. The total fuel consumption in Kabupaten Jayawijaya (Wamena) in 2009 is around 1500 tons/month. From 2002 to 2006, the central government (c.q Pertamina) supplied 590 tons/month of subsidized petroleum fuel, consisting of 210 tons kerosene, 110 tons automotive diesel oil (ADO), and 260 tons gasoline. Since 2007, however, the supply has been decreased to 450 tons/month, consisting of 175 tons kerosene, 70 tons ADO, and 205 tons gasoline. To obtain the subsidized fuel every 3-4 weeks, each vehicle and household is given a coupon that allows purchase of the subsidized fuel at the only Pertamina station in Wamena: maximum allowable purchases are 20 liters of premium for gasoline car, 25 liters ADO for diesel car, 5 liters premium for motorcycle, and 3-8 liters kerosene for household. The annual burden of the central government to provide these subsidized fuels – primarily in air transport cost from Jayapura to Wamena – amounts to Rp300 billion.

The needs for gasoline and ADO in excess of those granted through coupon have to be fulfilled by purchase at APMS (*Agen Premium Milik Swasta*, Privately Owned Fuel Agent). Due to the high cost of air transport, these fuels are quite expensive: the 3 APMSs currently operating in Wamena sell the fuel at Rp16,000 per liter. Understandably, the fuel price will be higher in other highland kabupaten (Tolikara, Puncak Jaya, etc.), because they obtain the fuel from Wamena. The APMS sell only transportation fuels; PLN and industry have to provide the needed fuels based on their own ways.

Potential biofuel resources. The fuel situation in Wamena (or Baliem Valley) represents a promising opportunity for biofuel industry development in the region, provided that the raw material is produced within the region itself. For biodiesel raw material provision, several oil crops were identified that posses potential for cultivation in the region: "buah merah" (*Pandanus conoideus*), "kelapa hutan" (*Pandanus julianettii*), sunflower (*Helianthus annuus*), and canola/rapeseed (*Brassica napus*). Both of the pandans are native plants of the region; the cooked fruit of "buah merah" is traditionally used as a food ingredient by the local population, whereas the fruit kernel of "kelapa hutan" could be eaten raw.

Research by the Biology Research Center of LIPI (the Indonesian Institute of Sciences) indicates that fruits of "buah merah" and "kelapa hutan" contain 36 and 51% oil (dry basis), respectively. Judging from the reported fatty acid compositions, both oils are suitable raw material for preparing cooking oil as well as biodiesel. Both plants still either grow wild or cultivated as subsistence crops, so no data are available on the fruit or oil productivity of a well managed garden or plantation. Sunflower is known to grow well in Wamena but is still unutilized for either cooking oil or biodiesel. Based on the agro-climate of the region (and the fact that other species of *Brassica* family such as vegetable cabbage and cauliflower grow well in the region), canola/rapeseed could presumably be grown well in the Baliem Valley. Both sunflower and canola/rapeseed are popular oil crops for both cooking oil and biodiesel in Europe and North America.

Sweet potato, the staple food of Baliem Valley's natives, is the most commonly available bioethanol raw material in the region. However, again because the crop is only cultivated under subsistence conditions, productivity (and tuber starch content) data of a well managed farm are lacking. Also based on the agro-climate of the highlands, sugar beet (*Beta vulgaris*) may be another bioethanol feedstock for the region.
An APMS operator stated that the private sector would be willing to invest in biofuel business if a pilot (demonstration) project on biofuel production and utilization in the area has indicated its viability.

Recommendations
Researches/studies, field trials, and then a demonstration project, have to be carried out to obtain information and data on:
- productivity data of the aforementioned crops in well managed plantation/farm plots;
- oil (or sugar/starch) content of the harvests;
- cost effective method for obtaining oil from the oilseed/fruit;
- feasibility/viability of biofuel production and utilization.

D. VISIT TO WAENA CAMPUS OF CENDERAWASIH UNIVERSITY (UNCEN)

Observation
As the month of July is the pause period between two subsequent academic years, little student and academic activities occur in the campus. Dr Ros Tanjung (biology lecturer who also head of University's Center for Studies on Environment) and Drs I Made Budi MSi (a creative and entrepreneurial biology lecturer) hosted the visit.

The Biology Department seems to have adequate facility and equipment (and even sophisticated molecular biology instruments) to carry out research. A research on biofuel from the seed of bintangur (*Calophyllum inophyllum*) is being carried out by a group of researchers in Chemistry Department. However, no information is available on whether the research is in a practical direction. Dr Ros Tanjung stated that she has never seen the fruit of mabai/mbau (*Pongamia pinnata*) and will make attempt to discover the tree in Papua. She would also make attempt to host a subsequent visit in the next academic period and organize a guest lecture/presentation in order to strengthen the capacity of the university's academic community to support biofuel industry development in Papua. In addition, she feels that there should be more contacts between the government and university researchers in order to increase the relevance of university researches with the development problems of the province.

Recommendations
- More regular and intense meetings among academics, businessmen, and government for exchanges in thoughts and opinions should be carried out to improve understanding between these three stakeholders and increase the relevance of university researches with the development problems of the province.
- Partnership between biofuel researchers of UnCen and those of leading universities in the country should be established.

E. VISIT TO RED PANDAN OIL SHOP OF DRS I MADE BUDI MSI

Observations

In addition to lecturing at the Biology Department of UnCen, Drs I Made Budi MSi owns several business ventures in Waena (and also a furniture factory in Keerom). His creative and pioneering work in commercializing red pandan fruit oil ("minyak buah merah") for medicinal purpose has been recognized through an "Upakarti Award" from the President of Indonesia. A red pandan fruit oil extraction and purification unit is available at his business site in Waena and utilized for testing purposes. He stated that a similar but larger unit (capable of producing about 10 liters of oil per batch) is located in his factory in Wamena; the required red pandan fruits are supplied by the natives cultivating the pandan on a subsistence basis in Tolikara.

The production of red pandan fruit oil as developed and practiced by Mr I Made Budi is rather complicated, involving presto cooking, pressing the wet cooked fruit, filtration, centrifugation and vacuum drying. The product, therefore, is marketable only for medicinal purpose (a 150 ml bottle of the oil cost Rp130,000.-).

Recommendation

In order to produce oil suitable for further processing into cooking oil or biodiesel, a far less costly extraction method (such as the simple drying and pressing operations normally applicable to most oilseeds) needs to be developed.

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