Biofuel in Brazil and Asia

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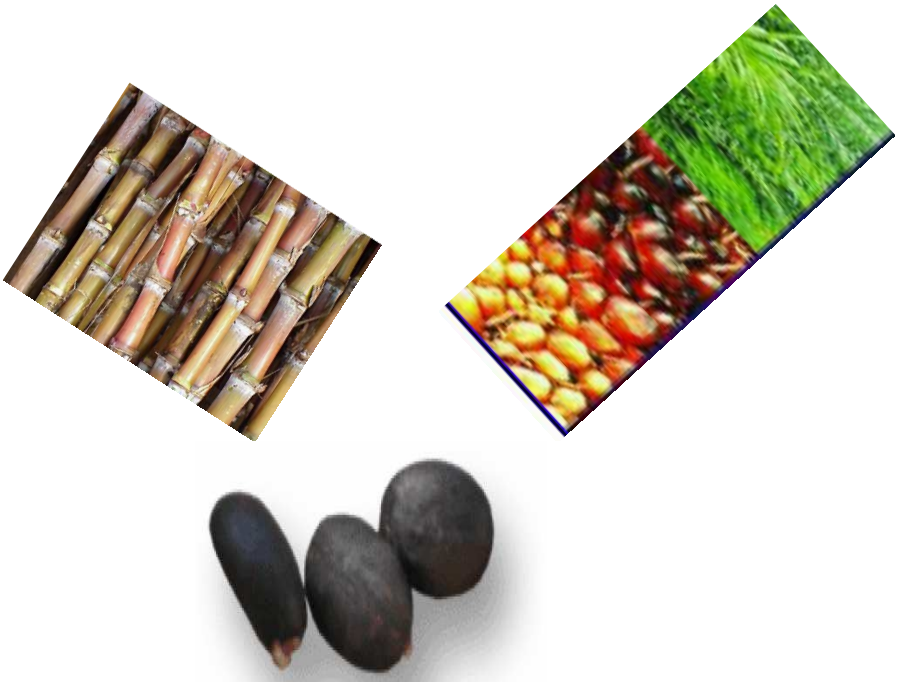

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1 Introduction

Bio diesel is very economical when compared to fossil fuel. For this reason the world production of ethanol production for fuel increased by more than fifty per cent between 2000 and 2005 whereas the world consumption of oil increased by seven per cent within the same period.

As the world's lowest cost producer of ethanol, Brazil rivals the United States as the leading volume producer, while ranking as the dominant exporter. Brazil's vast and untapped agricultural land resources leave considerable room to expand the production of sugar cane, the feedstock for the Brazilian ethanol industry. Biodiesel is a renewable fuel that can be produced from a number of feedstocks, such as rapeseed, soy, palm oil, and can be used as a substitute for fossil diesel. It can provide significant environmental benefits, such as 40-60% reduction in carbon lifecycle emissions.

2 Biofuel in Brazil

According to the Nigel Hunt [1], the two largest producers of ethanol are the United States and Brazil although there is also growing production in the European Union. Brazil is the world's largest exporter of ethanol, in 2007 exported 933.4 million gallons (3,532.7 million liters), representing almost 20% of its production, and accounts for almost 50% of the global exports.

2.1 Biofuel in the world

The following figures show the ethanol and biodiesel production in the world has been increased double since 2004 which explain the importance of the biofuel industry in the world.

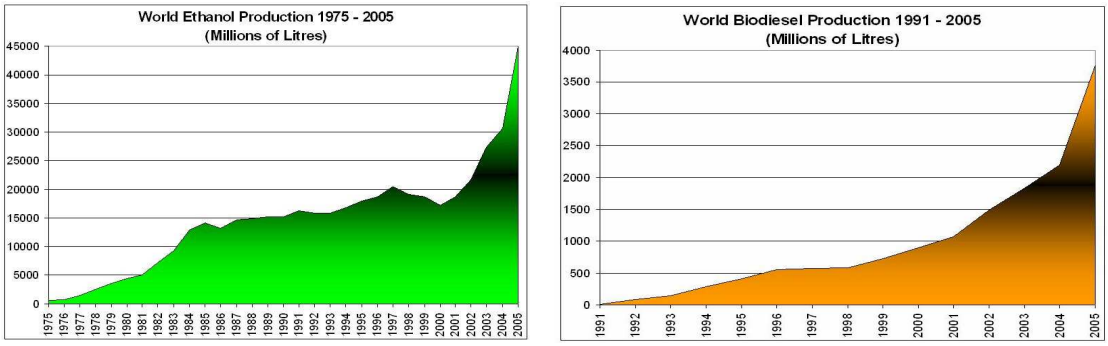

Figure 1- World Ethanol and Biodiesel Production

Biodiesel is produced by the chemical esterification of oils from oilseed crops such as soy, rape, mustard, or from other sources such as waste cooking oil. The United states have used the biodiesel from other sources more than the sugarcane biodiesel. They only use 3% of biodiesel from the sugarcane because the sugar industry in the United States has incentives in the world market as its sugar fetches the best prices. For this reason the country cannot diverge to the use of sugarcane for biodiesel like Brazil. However, the feedstocks of biofuel in Asia are mainly from palm oil. The following table shows feedstocks, production and blending targets of biofuel in the world.

Biofuel blending targets, selected countries					
Country	**Feedstocks**		**2007 production forecast (million gals.)**		**Blending targets**
	Ethanol	Biodiesel	Ethanol	Biodiesel	
Brazil	sugarcane, soybeans, palm oil	castor seed	4,966.5	64.1	25 percent blending ratio of ethanol with gasoline (E25) in 2007; 2 percent blend of biodiesel with diesel (B2) in early 2008, 5 percent by 2013.
Canada	corn, wheat, straw	animal fat, vegetable oils	264.2	25.4	5 percent ethanol content in gasoline by 2010; 2 percent biodiesel in diesel by 2012.
China	corn, wheat, cassava, sweet sorghum	used and imported vegetable oils, jatropha	422.7	29.9	Five provinces use 10 percent ethanol blend with gasoline; five more provinces targeted for expanded use.
EU	wheat, other grains, sugar beets, wine, alcohol	rapeseed, sunflower, soybeans	608.4	1,731.9	5.75 percent biofuel share of transportation fuel by 2010, 10 percent by 2020.
India	molasses, sugarcane	jatropha, imported palm oil	105.7	12.0	10 percent blending of ethanol in gasoline by late 2008, 5 percent biodiesel blend by 2012.
Indonesia	sugarcane, cassava	palm oil, jatropha	--	107.7	10 percent biofuel by 2010.
Malaysia	none	palm oil	--	86.8	5 percent biodiesel blend used in public vehicles; government plans to mandate B5 in diesel-consuming vehicles and in industry in the near future.
Thailand	molasses, cassava, sugarcane	palm oil, used vegetable oil	79.3	68.8	Plans call for E10 consumption to double by 2011 through use of price incentives; palm oil production will be increased to replace 10 percent of total diesel

					demand by 2012.
United States	primarily corn	soybeans, other oilseeds, animal fats, recycled fats and oil	6,498.7	444.5	Use of 7.5 billion gallons of biofuels by 2012; proposals to raise renewable fuel standard to 36 billion gallons (mostly from corn and cellulose) by 2022.

Figure 2 – Biofuel blend targets

2.2 Sugar cane Biofuel production in Brazil

Sugar cane has been known over the years as the major producer of ethanol. During ethanol fermentation, glucose is decomposed into ethanol and carbon dioxide. When this ethanol is mixed with gasoline at a ratio, it is referred to as Bio diesel. The fermentation process used to make ethafuel is exactly the same as the one used in the fermentation of alcohol.

In Brazil- which is the leading sugar cane producer, sugarcane has been used to produce bio fuel that runs motor engines. Brazil remains the largest world commercial bio producer of energy and consumer in the world. Brazil started using ethanol to run car engines in the year 1979. The increase in the prices of oil in 2005 raised the production and use of sugarcane ethanol in vehicles. Currently Brazil has half of its vehicles running on pure ethanol while the other 50% uses blends. The E10 or the 10% blend does not require any engine modification.

Brazil has the earliest largest and most successful bio-fuel programs in the world, involving production of ethanol fuel from sugar cane, and it is considered to have the world's first sustainable fuel economy. Sugar cane plantations cover 3.6 million hectares of land for ethanol production, with a productivity of 7,500 liters of ethanol per hectare. In 2006, Brazil produced 16.3 billion liters which represents 35% of the world's total ethanol production [3].

2.3 Purposes of Using Bio diesel in Brazil

Bio fuel in Brazil has four major roles. The first role of using bio fuel in Brazil is aimed at protecting the sugarcane plantation industry in the country which was facing serious crisis before due to overproduction of sugarcane that could not be absorbed in the sugar industry. The use of biofuel therefore provided a ready market for the sugarcane [2].

The ProAlcol project in Brazil was meant to increase the utilization of the local domestic resources of renewable energy. It gave the country an opportunity to develop on the capital goods in alcohol and process technology designed for alcohol production and its utilization. Brazil wanted to gain great social economical and regional equality by cultivating the viable land for production of alcohol. The industry also provided employment opportunities to the population with over 700000 being employed directly in the sugarcane industry and over two million people in the related industries. This saved the country about 400 million US dollars in import. Brazil has developed an agribusiness.

The other role of the use of Biodiesel in Brazil was to reduce environmental pollution that is emitted by the fossil fuels. By using the biodiesel, the country cut down the rate of pollution by more than 50% [2].

Brazil has over 300 plants producing ethanol and there are at least 100 more that are yet to be established. The recently integrated ethanol plant that was inaugurated by the Brazilian president Lula is a bio diesel plant called Dedin in the center of Brazil and 27 million real equivalents to 12.5 million US Dollars was invested in the project. This plant was constructed next to a big bio diesel plant that had been producing bio diesel for the last 20 years in Brazil. The government has also licensed the use of 2 % bio diesel from the oil seed crop. The increase in the world demand for bio diesel has also increased the production of bio diesel in Brazil. There are a total of 10 bio diesel producing plants in Brazil and some other 40 are under construction. In Brazil motorists can fill their engines with up to 100% ethanol at half the price of gasoline and there are over 30,000 ethanol filling stations in the country.

2.4 Characteristics of Sugarcane Bio diesel

Bio diesel has favorable combustion characteristics that have made it more preferable over the fossil fuel in most developed countries. First, bio diesel has a clean complete combustion in the motor engines and also octane rated performance is good. The internal combustion of engines designed to use alcohol fuel are energy efficient by 20% more than engines operated by gasoline. The fully combustion of the bio fuel makes them environmentally friendly since the emissions of Carbon dioxide, Lead, Sulphur dioxide and Carbon monoxide are greatly reduced.

The chemical properties of ethanol make it more volatile (evaporating from liquid to gaseous form) than gasoline and therefore cold start engines are a common problem with the vehicles using alcohol as fuel. This problem can however be resolved through modification of the engine and also changing the formulation of the fuel for example increasing the ratio of Gasoline to Alcohol in the bio diesel.

Alcohol has more energy content than gasoline; in fact one liter of gasoline has an equivalent two thirds of the energy in one liter of ethanol. This characteristics makes bio diesel more efficient in regard to energy saving. (International Atomic Energy Agency, 2006)

Ethanol is an organic product and is therefore biodegradable. It is safer for an alcohol spill on the environment because it will be broken down by bacteria than an oil or gasoline fuel that is non biodegradable. This chemical property of bio diesel gives it a special handling way over the fossil fuel.
Sugarcane is among the best photosynthetic efficient plant with about 2.5% efficiency in photosynthesis under optimal agricultural conditions. One of the bi products in the production of sugarcane called bagasse can also be used to produce electricity making a plant distilling alcohol a self efficient plant that generates surplus electricity.

The production process of ethanol is environmental friendly unlike the refinery of crude oil which produces a lot of waste products that are polluting the environment. The process of oil refinery also consumes a lot of power and labor as compared to the production of alcohol. The process of producing ethanol is simple and efficient and follows the following few steps.

First the growth of sugarcane, and harvesting and the transportation of the raw materials to the industry is very environmental friendly. It does not involve mining as in fossil fuel which causes environmental degradation [4].

The sugarcane is then taken for pre treatment (Conversion of raw material to a form suitable for fermentation). This process is very easy and does not have any serious environmental effects. The substrate is fermented to alcohol and then distillation is done to purify the alcohol. The residue of fermentation is treated to reduce pollution to the environment and obtain the by products. The technology of fermentation is being improved in order to reduce cost of production of ethanol fuel.

The production of bio diesel is common in the developed countries although there are some possibilities of the developing countries adopting the same. However in developing countries crisis occurs in the competition for land available for agriculture most of them being dependent on agricultural production.

The production of bio fuel increased between year 2000 and 2005 by over 20,000 million liters all over the world. In the year 2006, Brazil spent 0.20-0.30 Euros per liter equivalent to gasoline in its production of ethanol from sugarcane. This cost is far much below the costs incurred by the United States which was between Euros 0.30-0.50 from production of ethanol from corn while gasoline cost between Euros 0.3-0.55 and ethanol from grain in the European Union cost much higher, Euros 0.40-0.65 the same year.

2.5 Advantages and Disadvantages of Using Sugarcane Biofuel

There are two sides of everything, so we should discuss how much biofuel brings to us advantages and disadvantages.

2.5.1 Advantages

There are several advantages associated with the use of sugarcane biodiesel or ethanol biofuel in the cars. These advantages can be discussed in regard to the environment, the energy output, cost and availability. These factors have been discussed below.

a) Bio diesel and the Environment

Ethanol in even very low blends in gasoline, say for example, the E10 which contains 10% ethanol and 90% gasoline has great benefits to the environment. Tests that have been carried out in both Brazil and the United States show that the production of Carbon dioxide, Carbon monoxide, Sulphur dioxide is lower in combustion of bio diesel as compared to reformulated gasoline (RFG). E10 however produces more volatile organic compounds (VOC), Nitrogen (II) Oxide and particulates more than the Reformulated Gasoline. If E85 is burned, (E85 contains 85% Ethanol and 15% Gasoline), all the above pollutants are greatly reduced. Therefore biodiesel is environmental friendly and can reduce the effect of global warming today. Pure ethanol produces very little pollutants to the environment.

b) Energy Balance

The energy balance of ethanol from sugarcane as a fuel has been ranked the highest with an output/ input ratio of 2-8 after the cellulose ethanol that has an output ratio of 2-36. The amount of energy that ethanol produces is higher than the energy used to manufacture it; hence the use of biodiesel is energy saving [5].

c) Cost

The world's fuel prices changes day in day out and several countries rely entirely on oil imports from the Middle East and Asia. The prices rose sharply during the year 2005 and this made many countries to suffer especially the developing countries to cope with the high prices. Oil consumption was reduced in these countries with a drastic decrease in the car industry for the high prices of oil. Public transport was also affected with the increase in fares. However in Brazil, life continues to be cheaper and cheaper since ethanol goes for half price of gasoline. Using biodiesel is very economical and affordable [5].

d) Availability

Many countries produces sugarcane and they use gasoline in the sugar industry which is very expensive, the available sugarcane is reliable as a country can afford to grow sugarcane and stop dependency on importing oil.

2.5.2 Disadvantages

There are several limitations that have emerged with the use of ethanol fuel in Brazil. This is mainly from the agricultural side where there is fear of over expansion of the sugar farms reducing food production. With the use of biodiesel means that there have to be over utilization of arable farm.

Biodiesel is also unsuitable as it produces high amounts of nitrogen oxide emissions which are harmful to the environment. This can be reduced by blending the biodiesel with Fitcher Tropsch diesel or the liquid paraffin [2].

The transportation of biodiesel and its storage is very involving and requires a lot of management hence it is not easier to use biodiesel. This is as a result of its properties which make it undesirable for use in high concentration especially in low temperatures it becomes more viscous (does not flow). It is also a bit expensive to transport biodiesel as it cannot be transported through pipeline due to its nature.

Biodiesel cannot be used at low temperatures as it forms a gel that cannot be pumped by the engine hence causing serious engine problem and inconveniences to the car users. It reaches the pour point (The temperature below which the biodiesel cannot flow).

Biodiesel reduces the fuel economy as a vehicle can cover 10% more miles on one gallon of petrodiesel than with one gallon of biodiesel. Biodiesel damages the filters of the car engine as it has excellent solubility properties which allow it to dissolve particles requiring regular change of filters. Petrol diesel forms deposits in the vehicular fuel system of the engine which is safer as they can be removed [2].

3 Biofuel in Asia

In the previous, we discussed about Biofuel in Brazil which showed the main resources of biofuel is from sugar cane. However, in Asia palm tree and sugar cane are the main resources of biofuel.

3.1 Major policies on Biofuel in Asia

The bases driving Asia to biofuel production are energy security, economics and environments. In this section, we will introduce all major policies on biofuel in Asia and especially in Indonesia, Malaysia and Thailand.

3.1.1 Bases for Biofuel Policies in Asia

The following table shows the Bases for Bio fuel Policies in Asia. It tells us palm oil, the main feedstocks of Biofuel production in Indonesia and Malaysia. The main resource of bioufuel in Indonesia and Malaysia is palm tree, and Thailand is sugarcane.

Key components	Indonesia	Malaysia	Thailand
Resource Base	World largest producer of palm oil (18.5 million ton)	Second largest producer of palm oil(17.3 million ton)	Deficit in palm oil
	Cassava production (about 20 million ton)	Cassava production (about one million ton)	World largest exporter of cassava
	Sugar production (2.8 million)	Sugar production (x million ton)	Third largest exporter of sugar)
	Jatropha production is growing important	Jatropha production is growing important	Jatropha production is not developed

Figure 3 - Bases for Bio fuel Policies in Asia

3.1.2 Major Policies on Biofuel: Indonesia

- "Minister of Energy Decree No. 02/2004 on Renewable Energy Development and Energy Conservation" is focusing on biomass geothermal, solar, water, wind and wave.

- "Presidential Instruction No 1/2006 on Provision and Utilization of Biofuel and Presidential Decree No 5/2006 on Biofuel Development" focusing on energy diversification to fulfill national energy demand in the long-run.

- "Law No 30/2007 on Energy", stipulates efficient utilization of energy, improving added value, sustainable energy, human welfare, environmental conservation and national security.

- National Energy Blue-Print (2006): bio-diesel to fulfill 2 percent of total consumption diesel fuels by 2010.

- Bio-diesel from palm oil is the first priority, targeted about 62.000 kiloliters equivalent to 62.000 tons)

- The second priority is from *Jatropha,* which has been widely known by local farmers across the country

3.1.3 Major Policies on Biofuel: Malaysia

- National Biofuel Policy (August 2005): to encourage the production and usage of palm oil biofuel as an environmentally friendly alternative energy source, and to stabilize palm oil prices at higher level through increased usage of palm oil.

- There are three strategies: (1) production and utilization of biofuel for transportation, (2) production of biofuel for export, especially to the European market, and (3) commercialization of biofuel technology as a local technology.

- There are three plants in Malaysia, the first two plants are in Port Klang and third is located in Pasir Gudang, Johor.

- It is incentive to boost the new industry; the plants have been built MPOB in collaboration of, with the private sector. MPOB has an equity stake of 50 percent in each plant

3.14 Major Policies on Biofuel: Thailand

- The policies are specification of pure alcohol, gasohol 95 and gasohol 91. Government cars have to use gasohol; government offices can purchase gasohol engine care

- Alcohol producers are allowed to export alcohol (12 December 2006)

- The shift in government policy: it decides not to ban the sale of Octane-95 gasoline which was scheduled on1 January 2007

- Large number of old cars can't use gasohol. 42 percent (1.6 mil cars) of passenger cars in Bangkok are older than 10 years. There are at least 500,000 cars with carburetors.

3.2 Biofuel production in Asia

The four countries in Asia is leading on biofuel production in Asia are Malaysia, Indonesia, China and Thailand. The major feedstock of biofuel production in Malaysia and Indonesia is palm oil; however it is sugar cane in Thailand.

3.2.1 Malaysia

In 2004, Malaysia produced 14 million tons of palm oil from more than 38,000 square kilometers of land, making it the largest exporter of palm oil in the world [10]. The

majority of its crops go towards its traditional markets for personal hygiene and food use. The Malaysian Sime Darby conglomerate is its largest plantation operator, with 524,626 hectares of oil palms, mainly across Peninsular Malaysia, Sarawak and Sabah in Malaysia.[49] It also operates plantations in Sumatera, Kalimantan and Sulawesi in Indonesia, as well as production plants and refineries. The following picture shows the percentage of each area and the ownership of planted are which are private estates (60%), government (30%) and small holders (10%).

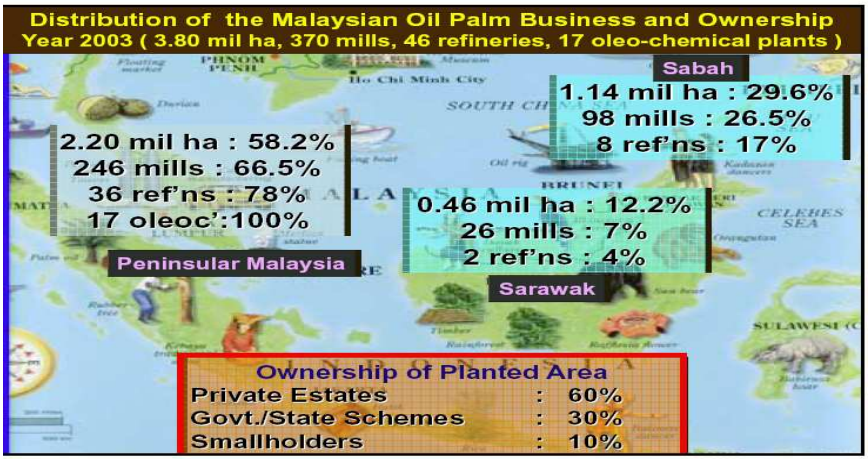

Figure 4 – Distribution of Malaysia Oil palm

Also, the total of oil palm land takes 62.27 % of the agricultural land use which is about 6.2 million ha.

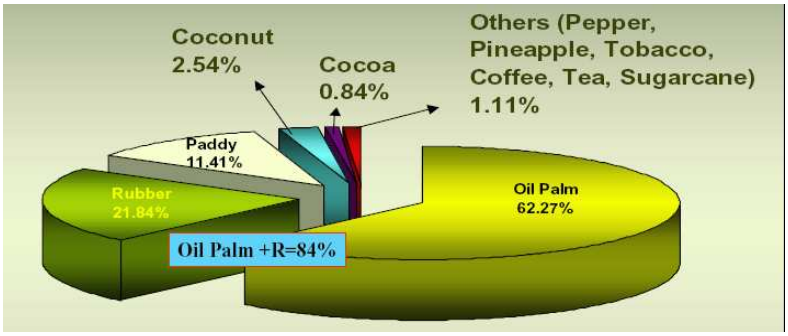

Figure 5 – Agriculture Land Use

The IEA predicts that biofuels use in Asian countries will remain modest. But as a major producer of palm oil, the Malaysian government is encouraging the production of biofuel feedstock and the building of biodiesel plants that use palm oil. Domestically, Malaysia is preparing to change from diesel to bio-fuels by 2008, including drafting legislation that will make the switch mandatory. From 2007, all diesel sold in Malaysia must contain 5% palm oil. Malaysia is emerging as one of the leading biofuel producers with 91 plants approved and a handful now in operation, all based on palm oil. Most are aimed at

supplying regional demand, though exports to Europe are also planned, with China currently the main importer of Malaysian products for biodiesel.

The importance of palm oil biofuel industry in Malaysia

- Third pillar of nations' economy and catalyst for rural development and resultant political stability
- Provide direct employment to 400,000 people
- Feeding the world: Malaysian palm oil is consumed in more than 150 countries world wide
- More than half a billion perennial carbon- sequestering palm trees
- Export constraints: producers did not plan their plant location and facilities for export because the policy was originally to substitute ethanol for imported MTBE: no tank trucks, too expensive tank farm, legal constraints for exporters

3.2.2 Indonesia:

In Indonesia, palm oil generated more than US$6 billion last year and growing energy crops in addition to food crops could, in theory, transform the lives of small farmers and help alleviate unemployment and poverty at the same time. Up to 70 percent of all households live in rural areas and biofuels promise salvation for the long-neglected agricultural sector. The big question is how Jakarta might go about cashing in on demand for palm oil, which could drive the expansion of large-scale oil palm plantations, which in Indonesia totaled 5.4 million hectares in 2005. The government plans to develop an additional 3 million hectares by 2010.

The below graph compared the palm oil production in Indonesia and Malaysia. The palm oil production in Indonesia is lower than Malaysia from 1964 to 2004. However, it has been increased quickly and higher than Malaysia since 2004.

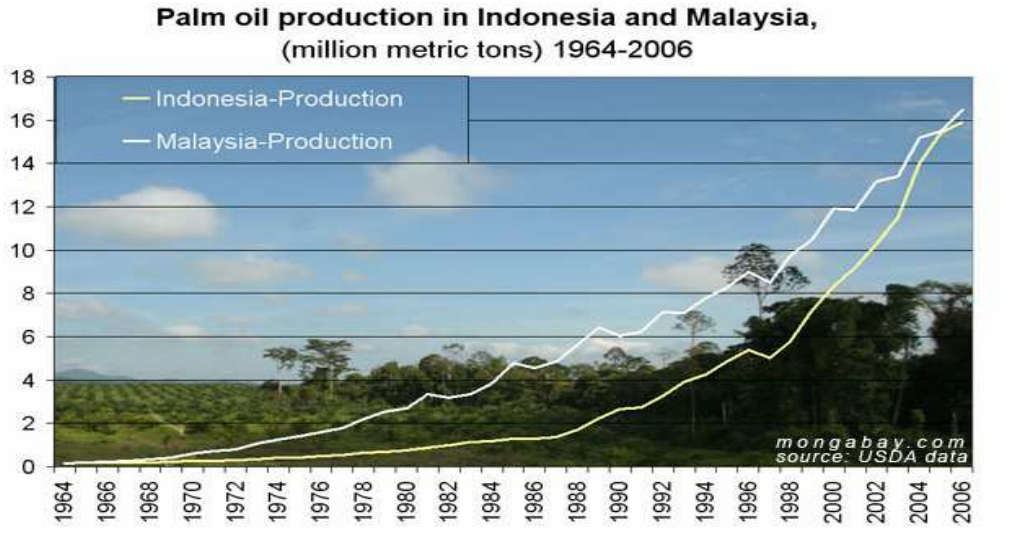

Figure 6 - Palm oil production in Indonesia and Malaysia

In future, Indonesia has a high expectation on *Jatropha* to encourage small farmers to participate. This crop is suitable in dry areas of eastern Indonesia such as: West and EastNusa Tenggara, Southeast Sulawesi, West Sulawesi, Gorontalo, Maluku,Papua (and Java). Estimates suggest that area potentials for Jatropha curcas in Eastern Indonesia is about 20 million hectare, where 7.5 million is for biofuel.

Also, energy-self-sufficient village is a program to fulfill the villages' needs on energy, create job, alleviate poverty, and improve capacity of local community. It is implemented gradually, starting from the villages that have been prioritized by the Government, state-owned companies, and private sector.

3.2.3 China

China is the third largest ethanol producer, with 964 million gallons in 2004 [13]. Since 2001, China has promoted ethanol-based fuel on a pilot basis in five cities in its central and northeastern regions (Zhengzhou, Luoyang and Nanyang in Henan and Harbin and Zhaodong in Heilongjiang province). The Jilin Tianhe Ethanol Distillery, the largest in the world, is producing 240 million gallons per year, and has a potential final capacity of 320 million gallons per year.

China on the other hand produces very little, 2000 million liters of biodiesel which cannot meet the large population needs in the country. The land in China is not favorable for the production of sugarcane and also the expansion of sugarcane plantation would lead to serious food problem to the large population.

3.2.4 Thailand

Looking back the major policies in Thailand, there are some following thoughts about biofuel in Thailand.

- Renewable energy has been concerned in Thailand especially gasohol and bio-diesel that can be implemented.

- Research and development of gasohol and bio-diesel becomes more important especially for the implementation.

- Strategic plan on gasohol and bio-diesel has been taken into the country most important policy and followed.

- Increasing the area for plantation of those agricultural plants that are used as raw materials of gasohol and bio-diesel are promoted

Production fluctuates in the range of 47-74 million tons, depending on rainfall as most production areas are rain-fed and about 67% of sugar production are exported [14].

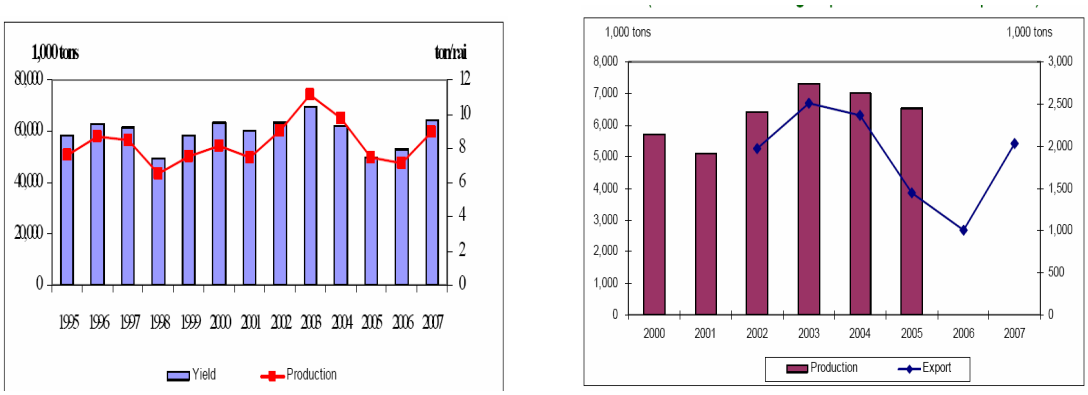

Figure 7 – Production of sugar and exportation in Thailand

3.3 Environment affection and protection

The combustion of fossil fuels such as coal, oil, and natural gas has increased the concentration of carbon dioxide in the earth's atmosphere. The carbon dioxide and other so-called greenhouse gases allow solar energy to enter the Earth's atmosphere, but reduce the amount of energy that can re-radiate back into space, trapping energy and causing In the case of ethanol from corn Stover, we have calculated that reduction to be 113%.global warming.

One environmental benefit of replacing fossil fuels with biomass-based fuels is that the energy obtained from biomass does not add to global warming. All fuel combustion, including fuels produced from biomass, releases carbon dioxide into the atmosphere. But, because plants use carbon dioxide from the atmosphere to grow (photosynthesis), the carbon dioxide formed during combustion is balanced by that absorbed during the annual growth of the plants used as the biomass feedstock—unlike burning fossil fuels which releases carbon dioxide captured billions of years ago.

Producing ethanol from cellulosic material also involves generating electricity by combusting the non-fermentable lignin. The combination of reducing both gasoline use and fossil electrical production can mean a greater than 100% net greenhouse gas emission reduction.

3.3.1 Deforestation

Superficially, it looks politically altruistic for a politician [11], Jope to say "we are going to replace dwindling reserves of fossil fuels with renewable biofuels. We are now seeing the prospect of very material deforestation."

From the "Tropical deforestation rates" below [9], we can see that Brazil is on the top of deforestation with more than 3000 thousand hectares per year. Indonesia is the second country in deforestation. However, Malaysia is very low in deforestation with 200 thousand hectares per year.

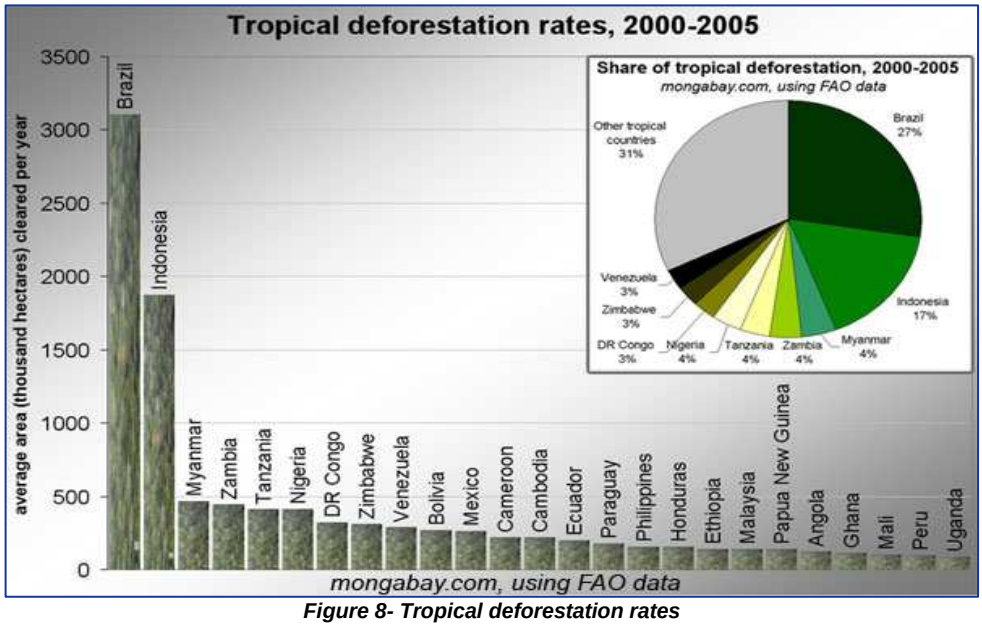

Figure 8- Tropical deforestation rates

3.3.2 Carbon Emission - Reforestation

Biodiesel has been promoted as a form of biomass that can be used as a renewable energy source to reduce net emissions of carbon dioxide into the atmosphere.

Reforestation is the one that actually removes carbon dioxide from the atmosphere and puts it somewhere else, i.e., into the mass of a live, growing forest. Also, scientists know that deforestation is responsible for about 25% of climate change, making reforestation a vital part of reducing emissions while providing time to transition to a clean energy economy [12].

Reforestation, if several native species are used, can provide other benefits in addition to financial returns, including restoration of the soil, rejuvenation of local flora and fauna, and the capturing and sequestering of 38 tons of carbon dioxide per hectare per year

3.4 Challenges for bio fuel development

The following challenges for biofuel development that Asian countries have:

- Major research challenges remain on food, fuel, feed
- Inter-linkages in resource allocation and product use
- Non-food commodities are likely to become alternatives

- Rural industry development and employment creation
- The roles of local government, civil society groups to improve social capital and governance in the policy making process.
- Macroeconomic elements, trade and development:
    - Indonesia: struggle to stabilize the price of cooking oil
    - Malaysia: Sustainability concerns, other feedstock advantages
    - Thailand: Gradual liberalization by introducing sugar price-band

4 Conclusion

The use of biofuel is very reliable as the advantages out does the disadvantages. It is also the only way that the conservation of the environment and the world from the alarming global warming can be achieved. Fossil fuels are the greatest pollutants of the environment known ever as they produce large amounts of Carbon products. Brazil is the only leading country in Europe and the world in the production and use of biofuel.

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