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FOOD SCIENCE & TECHNOLOGY | REVIEW ARTICLE

Upgrading of Malaysian palm oil biofuel industry: Lessons learned from the USA and Germany's policies

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Abstract: As one of the leading global producers of palm oil, Malaysia has the potential to play a pivotal role in global palm oil diesel production. However, such potential will be difficult to exploit based on the industry's current scenario. The new framework, known as "Strategic Dimensions and Implementation of the National Biofuel Policy in Malaysia", is vague and the current level of implementation is limited. Thus, a comprehensive and well-structured policy framework for Malaysia's palm oil biofuel industry is not only important in ensuring that its products, such as biodiesel, meet global standards but also to provide greater benefit to the industry as a whole. This paper presented a brief overview of German rapeseed biodiesel and US corn ethanol policies, aimed at providing a new perspective that can be adopted to reshuffle the existing policies governing the Malaysian palm oil biofuel industry. Throughout this paper, different strategies and policies designed to protect the biofuel industry in the US and Germany are discussed in this study. Such policies would be a good benchmark for the Malaysian government to emulate in an effort to improve its existing policies, strategies and blueprints relating to the palm oil biofuel industry development. This review also contributes to the oil palm industry, particularly in developing countries, by highlighting the importance of comprehensive policies and strategies in accelerating its development.

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PUBLIC INTEREST STATEMENT

Malaysia government started implementing policies for the palm oil industry in Malaysia 40 years ago. The policies led to significant development and achievements of the industry. Nevertheless, some policies are not taking into account the current production capacity of the industry. Industrialised countries such as Germany and the US have highly developed biofuel policies; their respective biofuel industries have also overcome considerable challenges. Therefore, studying the development of their industry could be useful for the Malaysian biofuel industry. Learning from other bio-economy programmes and policies, such as the US and Germany, the benefits of biodiesel policy if it were well implemented are as follows: first is enhancing the development of a bioeconomy market and stabilising palm oil demand. Second, it would help create value-added palm oil products and enhance socioeconomic development.

Subjects: Development Studies, Environment, Social Work, Urban Studies; Social Sciences; Economics, Finance, Business & Industry

Keywords: palm oil; biofuel; biodiesel; policy review

1. Introduction

Biodiesel in Malaysia is produced under the Promotion of Investment Act 1986. Malaysia has had a comprehensive biofuel programme since 1982. Palm oil has high use potential because of its high yield per hectare and high oil content. Its production per hectare is 27 times higher than other oil seeds. Palm oil biodiesel emits 62% fewer greenhouse gas (GHG) emissions than fossil fuels; it also has better performance than soybean (40%), rapeseed (45%) and sunflower biodiesel (58%) (Abdullah, Salamatinia, Mootabadi, & Bhatia, 2009; Sani, 2009).

Malaysian palm oil biodiesel contributed to approximately 59% of global warming potential; 58% of cumulated non-renewable energy demand; 380% of summer smog potential; 340% of excessive fertiliser use and 500% ecotoxicity compared with other unblended biofuels (Zah et al., 2007). As one of the leading global producers of palm oil, Malaysia has the potential to play a pivotal role in global palm oil diesel production. However, such potential will be difficult to exploit, based on this industry's current scenario. For instance, the sale of B5 biodiesel blend (5% biodiesel: 95% petroleum diesel) has been delayed for a few years and the lack of subsidies has placed Malaysian palm oil biodiesel in an uncertain position.

In terms of methods, the paper is based on in-depth qualitative interview and documentary analysis. We interviewed experts including president of the Malaysian Palm Oil Council and former director of the Malaysian Palm Oil Board (MPOB), the head of the Trade and Development Unit of the MPOB in Kelana Jaya, the former director of the Farmers Organisation Authority (FOA) in Negeri Sembilan, an FOA officer in Johor and a renewable energy policy design and pellet biofuel technology expert at the University of Duisburg, Germany. On average, the interviews lasted for one hour and the questions were based on individual expertise. In addition to this, we reviewed policy documents pertaining to the biofuel policy in Malaysia, rapeseed industry policy in Germany and bioethanol policy in the USA.

This study argues that a comprehensive and well-structured policy will be key to successful market penetration internationally. Thus, in this regard, several strategies adopted in the development of the rapeseed industry policy in Germany and in USA will be reviewed in this study. This study will concentrate on the corn bioethanol policy in both countries. These two countries have been chosen because of the proven approaches in their policy frameworks that have managed to spur an exceptional growth in their bioenergy industries. Briefly, the objectives of this study are: (1) to review the policies of German rapeseed biodiesel and US corn ethanol and (2) to propose a policy framework of biofuel production for the Malaysian palm oil industry. By focusing on these objectives, the paper will consequently provide a contribution in terms of policy studies for biofuel industry development and propose a more comprehensive and well-structured policy framework for the Malaysian palm oil biofuel industry. Next, it also offers a contribution concerning how market penetration can be materialised for biofuel industries in Malaysia through comparing biofuel policies in Germany and in the USA.

In order to meet the said objectives, the paper is divided into sections. The first section delves into the Malaysian biofuel policy, focusing particularly on its issues and challenges. The next section will review international biofuel policy in Germany and in the USA. The last section provides a comparison of the policies, summary and recommendation to the Malaysian Palm Oil Biofuel Industry.

2. Malaysian biofuel policy: Issues and challenges

The National Biofuel Policy was designed through extensive consultations with all stakeholders based on the research findings of the MPOB, since 1982. The Malaysian government has invested in biodiesel technology research and development (R&D) conducted by the Standards and Industrial Research Institute (SIRIM), the MPOB and local universities. A technology transfer (TOT) seminar was

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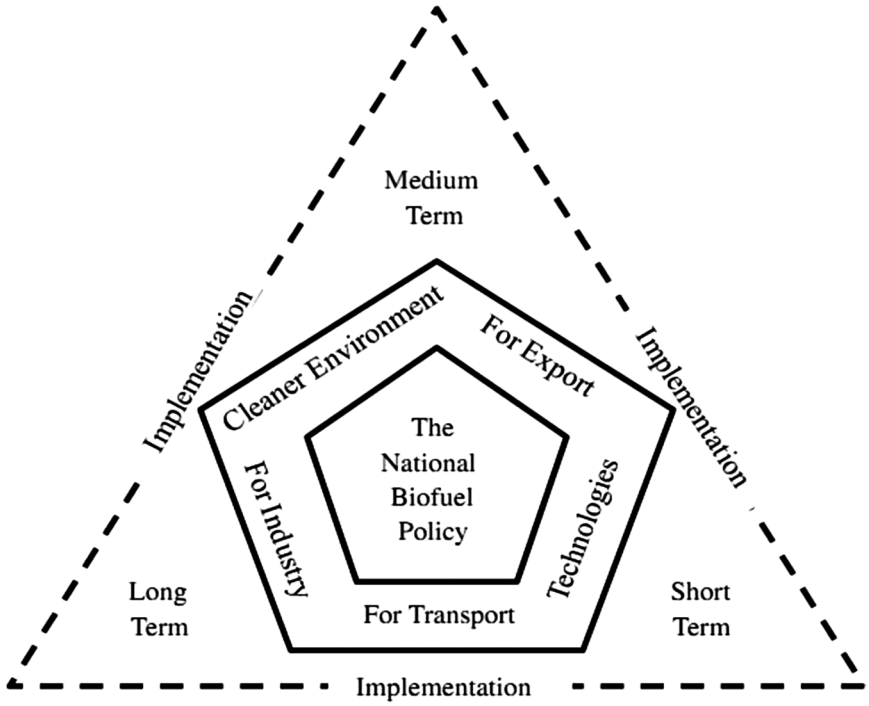

Figure 1. Strategic dimensions and implementation of the National Biofuel Policy in Malaysia.

Source: Adapted from Abdullah et al. (2009).

held to disseminate research findings among related domestic industries. The Malaysian biodiesel policy was designed based on the United Nations Framework Convention on Climate Change (UNFCC) and European Union (EU) policies as guidelines. The critical factors that were considered during the drafting of the Malaysian biodiesel policy cover: (i) competitiveness of the European (EU) economy; (ii) security of the energy supply and environmental protection (Bozbas, 2008; Yatim, 2009). However, the implementation of this policy had been delayed because of high palm oil prices since 2008.

The new framework, which is also known as "Strategic Dimensions and Implementation of the National Biofuel Policy in Malaysia", is vague and the current level of implementation is limited (Figure 1). A more comprehensive policy on biofuel or biodiesel development in Malaysia should provide greater benefits for the industry. Moreover, policies may need to ensure that Malaysian biofuels meet global standards, including the European Standard Specifications for Biodiesel Fuel (EN 14214), the American Standard Specifications for Biodiesel Fuel (B100) and Blend Stock for Distillate Fuels (ASTM 6751).[1] As pointed out by Abdullah et al. (2009), the properties of typical palm oil biodiesel for both normal and low pour points can fully meet the European and ASTM (The American Society for Testing and Materials) standards without much difficulty. However, the current status of the palm biodiesel industry shows that many obstacles do remain.

Table 1 exhibits the biofuel consumption potential in Malaysia. Only 5% of the vehicles registered in the country in 2011 were considered as "goods" vehicles (that can consume biodiesel). The percentage of goods vehicles is low, relative to petrol-reliant vehicles. This may be a point on which future improvements could be made by the national biodiesel programme. The use of pure or

Table 1. The number of new motor vehicles registered in Malaysia, 2011

Motorcycles	Cars	Buses, taxis, hire and drive cars	Goods vehicles	Others	Total
9,985,308	9,721,447	180,998	997,649	545,867	21,401,269
46.66%	45.42%	0.84%	4.66%	2.55%	100%

Source: Malaysia road transport department in Wahab (2012).

blended biodiesel for this small percentage of vehicles could become a focus. Nevertheless, the market for biofuel is bigger and blended biofuel may be a good starting point.

A few years ago, the Malaysian government was optimistic because the country's biodiesel industry had yet to become economically viable (Wahab, 2012). The government expected that 500,000 tonnes of palm oil biodiesel would be produced from 570,000 tonnes of crude palm oil (CPO) by 2013. However, this target was unlikely to be achieved (Wahab, 2012). There are several issues in the Malaysian biodiesel industry that have led to underperforming yield, such as a lack of facilities. New facilities need to be installed in order to further develop biodiesel capacity and at present, the government provides subsidies for the construction of additional facilities in existing refineries.

Overcapacity is also an issue surrounding Malaysian biodiesel plants at their current production capacity. In 2011, the total biodiesel production in Malaysia constituted only 6% of the total current capacity of 2.7 million tonnes from 23 biodiesel plants. In 2004, the Malaysian government allocated US$16 million for low interest loans, US$3.3 million for federal grants, US$3.8 million to PETRONAS (a Malaysian government-owned company which develops oil and gas projects) and another US$3.69 million for R&D in 2006 (Goh & Lee, 2010; Rauch & Thöne, 2009).

In addition, the Malaysian palm oil biodiesel industry faces differential disadvantages regarding duties.[2] Malaysian biodiesel and CPO are subject to 30% export duties, whereas Indonesia imposes only a 2% export duty on biodiesel and 16.5% export duty on CPO (Wahab, 2012). As a comparison, the export tax rates imposed on the palm oil products of Malaysia's neighbouring country, Indonesia, are published on a monthly basis by the Indonesian Ministry of Finance.[3] In contrast, the export tax rates on Malaysian palm oil products are set by the Malaysian Royal Customs Department, Customs Act 1967, each month. In September 2014, the Malaysian government decided to waive export duties on CPO for both September and October 2014. The tax exemption was prompted by decreasing palm oil prices and increasing inventory. The Malaysian government believes that the tax exemption would stimulate demand for biofuel. Most importantly, this policy will increase the price of palm oil. This duty's differential disadvantage has probably contributed to Malaysia's drop in ranking among other palm oil producers, such as Indonesia,[4] Thailand and Colombia, which are more competitive biodiesel producers.

Biodiesel is still not economically viable in the Malaysian context due to the fact that it is heavily subsidised (see amongst others, Ludin et al., 2014; May, Ngan, Weng, & Basiron, 2005). Substitution of petroleum diesel, such as bio-diesel, for transport applications is one of the ways in which the palm oil industry may use alternative energy resources, especially bearing in mind that, in Malaysia, an increasing energy demand in palm oil plantations is to be made sustainable, in line with declining reliance on fossil fuels (Ludin et al., 2014).

There is a lack of research into Malaysian farmers' involvement in bioenergy development. The existing literature is notably inadequate in explaining such development across different countries and feedstock contexts (Chin, Choong, Alwi, & Mohammed, 2016). A recent study of Malaysian smallholders planters in supplying their residues to biofuel producer using the application of theory of planned behaviour pinpoints how smallholders planters intention in supplying oil palm residue is determined by attitude, subjective norm and perceived behavioural control (Chin et al., 2016).

Furthermore, NGOs and industrialised countries have been continually highlighting sustainability issues, such as land degradation, GHG emissions and biodiversity losses; land tenure issues, labour issues, social issues, biofuel and biodiesel implementation issues and other policy-related issues. Although several environmental policies have been laid down, more effort is needed to address the concerns of industry critics (Malaysian Palm Oil Council, 2007). Given that the EU is concerned about the sustainability of the palm oil industry, these are possible barriers to market entry for Malaysian biodiesel exports.

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Palm oil industry players in Malaysia display scepticism towards academic research due to the fact that the recommendations and results of study are frequently made in an academic format, with minimum or no assessment and guidelines regarding practical applicability (Hansen et al., 2015).

3. International biofuel policy review: Germany and USA

3.1. Germany rapeseed biodiesel policy

The rapeseed biodiesel production in Germany is limited by weather conditions. Thus, several strategies and policies have been designed to protect this industry, which is important for both domestic and export market. The main objectives of biofuel policies in Germany are to reduce GHG emissions and to ensure the nation's energy security. These policies cover: (i) the government support through tax exemptions; (ii) mandatory blending targets; (iii) quota trading system; (iv) support scheme; and (v) advanced comprehensive research.

Under the government support through tax exemptions, the German government implemented its biofuel and biodiesel policies in stages. Only biofuels in pure form are given full tax exemption (Federal Government of Germany, 2004). The impacts of this policy can be observed in the expansion of the B (100) biodiesel market and the increment of relevant government fiscal budget. Moreover, the eco-tax on fossil fuel has been increasing in Germany. The eco-tax complements the full tax exemption, thus driving biodiesel prices below that of fossil fuel. As shown in Figure 2, in 2005, tax exemption for biodiesel was at its highest at €0.47 per litre. Biodiesel sales were 6% higher than the sales of other types of diesel in Germany (Wiesenthal et al., 2009).

A mandatory biofuel blending target was introduced for the petroleum industry in 2007. Petroleum companies can meet the quota either by (1) blending diesel, (2) blending petrol, or (3) producing pure biofuels. The government uses a hybrid quota system to give tax exemptions on pure biofuels and to encourage petroleum companies to meet the quotas. Petroleum companies may delegate their quota requirement to third parties interested in producing biofuels for the market. If a petroleum company fails to meet quotas set for petrol, a penalty of €43 per gigajoule (GJ) will be imposed on them with an additional €19 GJ^{-1} charged to the company in the case of diesel (Leopoldina, 2012).

While under the quota requirements, a quota on the respective petroleum companies is allowed to be used by a third party. This means that biofuel producers may sell their extra quota to petroleum companies and tax exemptions are provided only for pure biofuels. For instance, if pure biodiesel production exceeds the quota, tax exemptions granted to pure biofuels producers have to be returned to the government. The quota trading system may help petroleum companies to meet quotas and evade penalties. As a result, the costs of tax exemptions for pure biofuels can be reduced. German policymakers regard the fiscal burden caused by tax exemptions. However, the burden is offset by the penalties paid by the petroleum companies (Leopoldina, 2012).

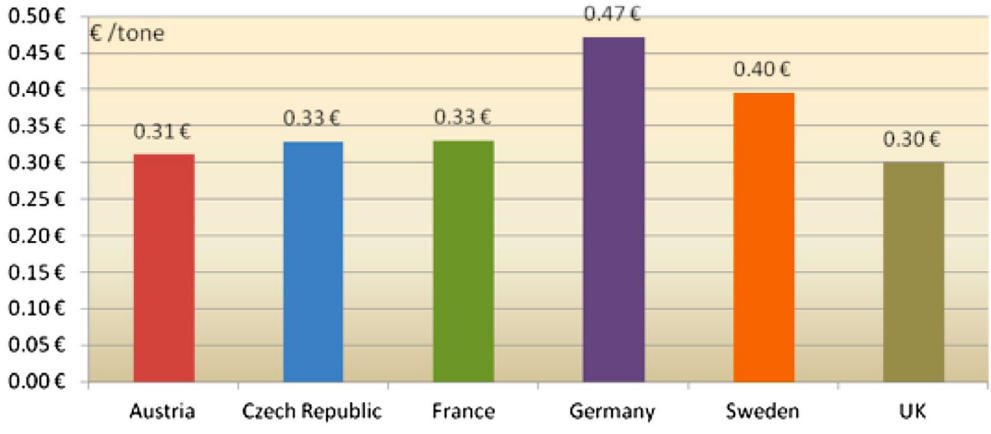

Figure 2. Tax benefits for biodiesel in member states of the European Union in 2005.

Source: Adapted from Wiesenthal et al. (2009).

As biofuels are costlier than fossil fuels, a few support schemes have been introduced. They include subsidies for farmers through Single Payment Scheme (SPS) and sustainability standard cost. The SPS was introduced in 2009 as a premium for biofuel crops. This scheme is dependent on two factors: the area under cultivation and the payment entitlements. In this scheme, the fixed costs of a farm (for both food and energy crops) are reduced. As a result, market competitiveness exists between biofuels and fossil fuels (Leopoldina, 2012) while the sustainability standard cost has been introduced since the biofuel industry policies are inefficient. There are over capacity plants in Germany and contractual prices linking vegetable oils and fossil fuels (Leopoldina, 2012). Hence, the biofuel industry in Europe, including Germany, is required to comply with the sustainability criteria of article 17 of the EU RED.

It was expected that the amount of land in Germany used for bioenergy crops could be increased from 2.5 million hectares to 7.3 million hectares from 2020 to 2030 (National Biomass Action Plan for Germany, 2009). Currently, 19% of the croplands in Germany are used to cultivate energy crops: rapeseed cultivation, primarily used for biodiesel and biogas production, occupies 86% of that area (2.0 million hectares). However, the availability of agricultural land in Germany is decreasing as residential areas and transportation infrastructure is expanding. Thus, the current environmental and conservation policies have reduced the rate of land development. Arable land that would otherwise be used to cultivate other crops is allocated for fuel crops.

In terms of research, there are a number of prior researches that have been conducted over the years. In 2012, the Bioeconomy Council has studied the potential of achieving bioeconomy and found that biomass residues are yet to be fully utilised (Bioökonomierat, 2012), whereas the German National Academy of Sciences Leopoldina was involved in evaluating the availability and sustainability of biomass as an energy source. They found that the total biomass harvested in Germany is decreasing. They also conducted a research on biofertiliser[5] with the main aim of improving the current practice in the agricultural industry, as this sector contributes up to 35% of global GHG emissions. The scope of research conducted by the German National Academy of Sciences also covers the areas of bioenergy potential; human appropriation of net primary production and bioenergy potential; energy return on investment; area efficiency; GHG fluxes; fossil fuel cost of net primary production, energy returns on investment, area efficiencies and capacity credits; GHG emissions associated with net primary production; CO_2 costs of biomass conversion into biofuel; sustainable intensification of crop yields as well as computing net primary production (NPP) in terrestrial systems and primary energy consumption.

Unlike other European countries, some of the biodiesel mills were established close to the vegetable oil mills. Thus, transaction costs incurred from plantations to mills are fairly low. According to Leopoldina (2012), the significant growth of the biodiesel industry in Germany has been due to tax exemption for clean biodiesel blends, facilitation of investments at state level, conformity among plants, technological knowledge and experience, as well as excellent production and processing facilities.

3.2. US corn ethanol policies

The Renewable Fuel Standard (RFS) established by the US Energy Policy Act 2005 offered additional incentives for the production of ethanol biofuel. The combination of these incentives and low corn prices contributed to rapid growth in the production of, and the demand for, ethanol biofuel. As the demand for ethanol biofuel increased, supplies tightened and the price of corn increased sharply, thereby lowering profit margins. Nevertheless, technological advances in corn oil extraction and alcohol distillation compensated for the depressed profit margins (Agricultural Marketing Resource Center, 2013).

In recent decades, the number of farms that produce corn, sorghum, barley and oats in the US has been declining as a result of increasing corporatisation of agricultural production, leading to lesser but larger "farms". The number of large corn-producing farms (more than 200 hectares) has

increased, while the number of small-scaled, individual or family-owned farms has decreased significantly (USDA, 2012). Therefore, agricultural policies in the US were designed and aimed to protect farmers' income via flexible contract payments, marketing loans, disaster aid, conservation payments and crop insurance. Moreover, the government also used market instruments to support corn producers, including import fees, duties and import quotas on sugar (USDA, 2012).

The policies that directly address ethanol biofuel production from corn are part of the Food, Conservation and Energy Act of 2008 (2008 Farm Act), which provides corn producers access to the following marketing loan benefits, such as Marketing Loans, Direct payments (DPs), Counter-cyclical payments (CCP), Average Crop Revenue Election (ACRE) programme, Revenue guarantees and Payment Limits (Participant Selection).

The Marketing Loans allow producers to repay commodity loans at lower rates than the original interest rates when "posted county (local) prices" are below the projected value considered in the commodity loans. The direct payments (DPs) provide eligible landowners and producers annual contracts with the Farm Services Agency (FSA) in the USDA, whereas the counter-cyclical payments (CCP) are paid whenever the target price of a commodity is greater than the calculated effective price for that commodity.

The Average Crop Revenue Election (ACRE) programme was started in 2008, based on the Farm Act and administered by the FSA. In this programme, farmers can choose either a "revenue-based counter-cyclical programme" or CCPs. Producers who choose to participate in ACRE will have a reduction in DPs and marketing assistance loan rates. ACRE payments will be made: (1) if "the actual state revenue per acre falls below the state guarantee per acre," and (2) if "actual farm revenue per planted acre falls below the farm benchmark revenue per acre" (USDA, 2012).

Revenue guarantees are mainly for the respective commodities under the ACRE programme. These guarantees are provided to participants each year according to "national market prices and State-level average planted yields" (USDA, 2012), while the Payment Limits (Participant Selection), the highest amounts paid to participants, are US$40,000 per person through DPs and US$65,000 through CCPs. These limits were set by the 2008 Farm Act. As for marketing loan benefits (MLGs and LDPs), no threshold for the highest amount was set. If farmers earn an "adjusted gross farm income" greater than US$750,000 (up to three years on average), they are not qualified for DPs but may qualify for other programmes. Farmers with an "average adjusted gross non-farm income" of more than US$500,000 (up to three years on average) may not qualify for DPs and CCPs, ACRE payments, marketing loan benefits or disaster payments.

Under the insurance programmes, farmers may purchase crop insurance (to hedge against harvest risks) and revenue insurance to protect against revenue losses regardless of the source of losses. The USDA pays a portion of insurance premium for producers and also a part of the transaction costs (delivery and administrative costs) of private insurance companies. Moreover, the 2008 Farm Act included a "Supplemental Agricultural Disaster Assistance" to assist farmers who lose earnings because of natural disasters or catastrophes. Farmers who bear more than 50% of normal losses are also eligible for the insurance (USDA, 2012).

According to the 2008 Farm Act, under the environmental and conservation programmes, all arable land (including fallow land) is supported for conservation. In this programme, farmers are required to select and to implement an approved conservation plan. Conservation programmes, including the "Environmental Quality Incentives Program" and the new "Conservation Stewardship Program", may help provide assistance for areas of land that are still used for crop production. Land retirement programmes, such as the "Conservation Reserve Program" and the "Conservation Reserve Enhancement Program", reward farmers for not cultivating crops on environmentally sensitive land. The area managed under the Conservation Reserve Program has been reduced from 15.9 million hectares to 13 million hectares since 2010, according to the 2008 Farm Act (USDA, 2012).

In terms of export and food aid programmes, USDA Foreign Agricultural Service and the US Agency for International Development (USAID) have been given the responsibility. They help to publicise and reinforce trading of US feed grains in international markets through the "Export Credit Guarantee Program", the "Market Access Program" and the "Foreign Market Development Program". Export credit guarantees are designed to help foreign importers who are constrained by foreign exchange rates and those who need credit to buy US commodities. The respective institutions guarantee the commercial financing of US agricultural exports through repayment of private and short-term credit for three years. The institutions do not offer financing, but they underwrite payments from foreign banks, which allow US financial institutions to offer competitive credit terms to foreign banks (USDA, 2012).

Extensive campaigns are also been conducted to make farming practices, such as usage of fertilisers and pesticides, transparent to consumers. These campaigns are intended to improve public perception of agricultural practices (Corn Refiners Association, 2012).

4. Policy comparison: Summary and recommendations

Learning from the biofuel industries in Germany and the US, the Malaysian biofuel policymakers should take into account the importance of: (1) protecting an infant industry, such as using the Common Agricultural Framework in the EU, (2) market entry amid existing trade barriers and (3) comprehensive policies to establish and maintain the industry. These are the lessons learned.

From these two international examples of bioeconomy and biofuel policy, the Malaysian palm oil industry could emulate the potential of using subsidies to protect farmers and hybrid quota trading systems (to balance government spending and income). The industry could also promote the use of pure and blended biofuels, taxes on petrol, crop and revenue insurance, environmental and conservation programmes, export and food aid programmes and public relation campaigns.

The Malaysian federal government may also consider a trade agreement between Behn Meyer (Germany) and the MPOB, as the Malaysian palm oil industry is highly dependent on fertilisers imported from Germany. The German-Malaysian fertiliser chain (Figure 3) involves inputs coming from Germany and palm oil end products exported from Malaysia to Germany. There were two matters that would benefit both countries. The bureaucratic regulation regarding the labelling of fertilisers can be conducted at the early stage of fertiliser production in Germany. As a result, production costs could become cheaper. The MPOB would like to establish a procedure for labelling fertilisers with their respective formulas.[6] However, according to our interviewee at Behn Meyer AgriCare, this would increase bureaucracy and costs and lead to inefficiency. Fertiliser trading companies would need to go through a number of segments in the supply chain before their products could be retailed to farmers.

Furthermore, since oil palm empty fruit bunches (OPEFBs) can be processed into biological fertiliser and Behn Meyer is a well-known expert in producing high quality fertiliser, a trade agreement (which facilitates the exchange of technological knowledge and experience and R&D cooperation between the MPOB research stations and Behn Meyer) may provide a win-win situation for both exporter and importer.

As a result, some of the EU commissions may also begin to appreciate the prospect of growing oil palm as a renewable energy crop for biofuel production. As the Malaysian palm oil industry is relatively productive (in terms of yield per hectare and yield per tonne) and Germany is the largest producer of biofuel, Germany could become the main importer of palm oil products, such as palm oil biofuels. In addition, Germany may be a consultant for a bioeconomy program in Malaysia. Producing palm oil biodiesel is costly, but Malaysia has to consider a policy design that fulfils sustainability requirements laid down by the EU and Germany if the Malaysian palm oil industry wishes to penetrate the EU market. With the trade agreement in place, palm oil biodiesel imported from Malaysia could be used to complement rapeseed production in Germany. Apart from the "food vs. fuel" debate surrounding rapeseed, Germany faces numerous obstacles in rapeseed production, amongst which are

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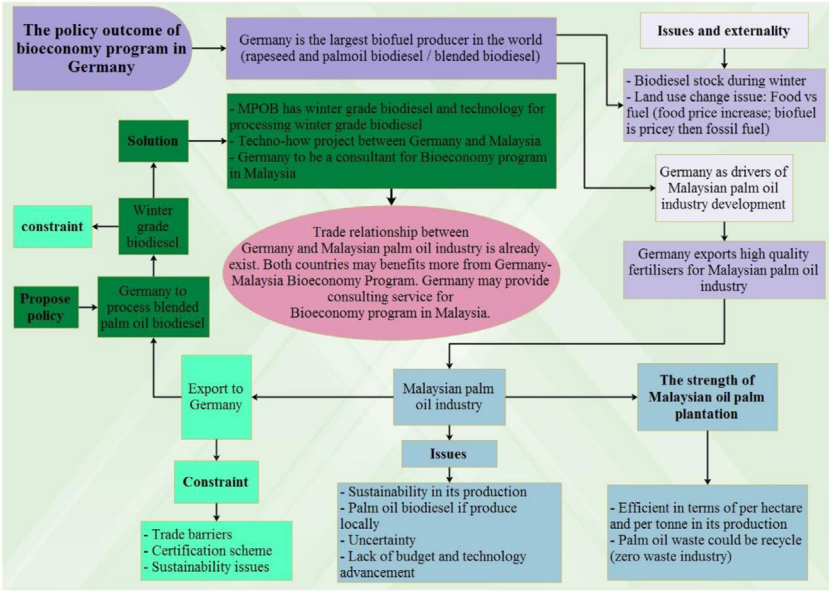

Figure 3. German-Malaysian bioeconomy policy framework.

Notes: Product flow 1 (Purple boxes): German exports high quality fertiliser for palm oil industry. Product flow 2 (Green boxes): Malaysia exports palm oil to Germany for biodiesel products. The arrows show the vicious cycle of oil palm inputs (Malaysia imports fertilizer from Germany) and how Malaysia exports its palm oil products to Germany. The blue and light green boxes: The blue boxes show the strengths and issues of palm oil production. The strengths of palm oil production lies in its high efficiency and potential to create zero waste, whereas its issues revolve mainly around the sustainability of its production. The trade barriers are also discussed, which need to be considered to establish in this framework. The dark green boxes: These boxes show the palm oil output in the German market. These boxes show the value added to Malaysian palm oil products by German biodiesel refineries. The constraints and issues faced by Germany in producing biodiesel and relevant sustainability issues are also noted in the boxes.
Source: Authors.

the seasonal changes in Germany. Therefore, importing Malaysian palm oil may be the best option for fulfilling the biofuel mandate and demand in Germany.

Crop Revenue Coverage (CRC) in the US is an example of options to mitigate producer risk (USDA, 2012). The Malaysian government could introduce a crop insurance system to protect growers from liability and risk. Insurance companies could calculate premiums according to profit targets. For example, producers who earn less than 50% of their normal profits would not have to bear the costs of operation or borrow money to compensate for their losses. In Malaysia, some people prefer to borrow money from private lenders, since they require less documentation and have fewer restrictions, but the private lenders impose high interest rates.

The Malaysian government should also encourage mills that still use conventional technologies to adopt more technologically advanced equipment to improve their ability to process oil palm fruit bunches. Although transitioning to new equipment would temporarily increase costs, this would have tremendously positive long-term impacts on processing capacity and profit margins. The German rapeseed biodiesel industry, the US corn bioethanol industry and even the Brazilian bioethanol industry (Rask, 1994) are examples of how government protection is vital to a biofuel industry and how investment accelerates its progress, especially during its infancy.

5. Conclusion

Forty years ago, the Malaysian government laid down policies for the Malaysian palm oil industry that led to tremendous development and achievements for the industry, allowing it to surpass West African countries to become one of the largest producers and exporters of palm oil in the world. Nevertheless, some policies are not in accord with the current production capacity of the industry. Thus, to improve future policy development, the current situation on the ground should be studied in depth, taking into account the obstacles and constraints of the policy adopted, since such an approach would be more reliable and not overly ambitious.

The developed countries, such as Germany and the US, have highly developed biofuel policies; their respective biofuel industries have also overcome considerable challenges. Therefore, studying the development of their industry could be useful for the Malaysian biofuel industry. The hybrid quota trading system (imposing the use of pure or blended biofuel, while controlling government spending) is an effective approach by the German government to incentivise the biofuel industry,

while crop and revenue insurance policies, adopted by the US, protect farmers from liabilities and losses. Due to challenges faced by palm oil growers in insuring their crops and revenue, such approaches could offer significant benefits.

Learning from other bioeconomy programmes and policies, such as the US and Germany, the benefits of a well implemented biodiesel policy are enhancing the development of a bioeconomy market and stabilising palm oil demand. Furthermore, it would help create value-added palm oil products and enhance socioeconomic development. Nonetheless, it is important to note that the international policies compared in this study might not be entirely applicable to the Malaysian palm oil biofuel industry because of differences between the developmental statuses of the three countries. However, such comparison is deemed necessary, given the country's aspiration to achieve the status of "developed nation" by the year 2020.

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Notes
1. A comparison of these standards can be viewed in Foon, May, Liang, Ngan, and Basiron (2005).
2. Interview with a high level MPOC official.
3. Based on a decree of the Minister of Finance No.439/KMK 017/1994.
4. For a review of the effect of export tax on Indonesian palm oil product, refer to Amzul (2010).
5. Biological fertilisers can be produced only through the fermentation of cellulose tissues; a process in which plants tissues are converted to biogas or bioethanol and residue (non-fermented lignin and lignocellulose). N_2O emission, which is also a problem of using chemical fertilisers, is inevitable during this conversion process.
6. Interview with a senior manager at Behn Meyer AgriCare (M) Sdn. Bhd.

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