

[OT 3] THE PROSPECTS OF BIOFUELS AS A GREEN SOLUTION TOWARDS SUSTAINABILITY

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ABSTRACT

Biofuel is an alternative, sustainable, environmental friendly and renewable source of energy. Biofuel has gained attention nowadays due to the potential of reduced environmental impacts as well as increased economic and social benefits. The purpose of this study is to examine the prospects of biofuel to the environment, economy and social. This study employs qualitative research method whereby the insight regarding biofuel was collected through interview with a practitioner in this sector. The findings show that biofuel causes less greenhouse gas (GHG) emissions and harmless to the environment. However, there are some biofuel which is made from crops can have negative environmental effects. There are serious impacts towards biodiversity conservation. This study found that it has positive impacts to the economy. By building the biofuel industries on the empty lands, this can generate economic benefits to the countries as the demand of biofuel is increasing. The new and existing biofuel industries can create and provide new job opportunities to the people. This can help them to improve and develop skills. As a result, their standard of living can be improved. However, the low awareness of biofuel in Malaysia reflects lack of policy to promote biofuel. Consequently, awareness on the potential of biofuel should be implemented in order to support the sustainability agenda of the country.

Keywords: *biofuel, environment, economy, social, sustainability*

INTRODUCTION

Conventional fuels, for examples fossil fuel, coal and natural gas are being depleted and becoming harder to find. However, the world is still heavily dependent on these fuels. Alternative fuel sources are needed to reduce the dependency on conventional fuels. Biofuel is one of the alternatives to replace conventional fuels. Biofuel is liquid transportation fuel made from biomass. The Biomass Research and Development Act 2000 explained biomass is available on plants and animal residues used for car, trucks, airplanes and trains. Unlike conventional fuels, biofuel can be produce in shorter time whereas conventional fuel requires millions of year to produce from the earth. Biofuel is a renewable resource and it plays a larger role in the supply of energy. Today, biofuels have become gradually essential because conventional fuel is constantly being depleted.

Biofuel group into three major categories based on types of feedstock used to produce them. The biofuel productions with a rate of 98 per cent are come from the production of biodiesel and ethanol (Msangi, Sulser, Rosegrant, Valmonte-Santos & Ringler, 2008). The first generation biofuel divided into biodiesel (oil seed) and bioethanol

(sugar); the second generation is generally not food crops (grass and willows) and the third generation is based on energy production from photosynthetic microorganisms. Biodiesel is the mono-alkyl esters of long-chain fatty acids created by chemically processing vegetable oil and animal fats (Vicente, Martinez & Aracil, 2007). Table 1 shows the types of biofuel along with the sources.

Table 1
Types of biofuel (Biemans et al, 2008)

First Generation		Second Generation	Third Generation
Biodiesel	Bioethanol		
Jatropha	Corn	Willows	Algae
Soy beans	Wheat	Poplars	
Palm oil	Sugar cane	Grass	
Rape seed	Sugar beets	Agricultural waste products	
Sunflowers		Forestry waste products	

Recently, Malaysia is the largest exporter in the world and the second biggest in producing crude palm oil (Hoh, 2009). The Malaysian government promotes the palm oil production in order to support Malaysia biofuel market. In 2006, National Biofuel Policy was launched by the government. The aim of this policy is to reduce dependency on conventional fuels by using environmentally friendly and sustainable energy sources as well as to stabilize and improve palm oil prices.

The production of biofuel has gradually increased in last several years (Gallagher, 2008). Rapid increase in biofuel production causes much debate over the environmental, economic and social impacts. Many countries start to shift towards biofuels because biofuel is an environmentally friendly alternative compared to conventional fuels. Environmental issues for example climate change and pollution of using fossil fuel should be concerned. The recent literature has focused on how biofuel production could affect the economy. In particular, it is important to investigate the social impacts of using and producing biofuel.

PROBLEM STATEMENT

By using and producing biofuel, it has numerous environmental, economic and social problems. All these have been debated in the scientific journals and media. The International Resource Panel highlighted the possible factors that need to be considered before decided to seek one biofuel over another. Not every type of biofuels can perform uniformly. He proposed that environmental, economic and social effects need to be measured all over the time. Therefore, awareness on the potential of biofuel should be spread to the public in order to support the sustainability agenda of the country.

Fossil fuels are non-renewable energy source and are extracted to an unlimited level which leads to depletion crisis. Fossil resources will last for a short period of time. One of the issues in this century is to find out the best way to obtain renewable energy for heat and light generations, transportations and industrial good production. In 2010, International Energy Agency stated that, fossil fuels supply almost about 80 per cent of the energy. The alternative energy supply around 17 per cent and the remaining is provided by nuclear energy. By 2020, the global consumption of fuel is expected to

increase by 50 per cent over the current rate. Therefore, production of biofuel is very significant so that it could sustain energy demand afterwards.

Pollution is one of the major disadvantages that are formed due to burning of fossil fuels. Fossil fuel gives out carbon dioxide (CO₂) upon burning. CO₂ is the major factor that results in the global warming. Rise in earth temperature has caused the melting of ice craps in polar, rising in sea levels and consequently flooding of low land areas. To prevent the situation from becoming worse, biofuels are considered as primary alternatives to fossil fuels for energy sources as they can reduce some environmental dilemma. However, we need to identify how the replacement of conventional fuel to biofuel brings to the environmental.

The demand of biofuel is increasing in 21st century and biofuel markets are developing rapidly. This can encourage the economic growth by carrying out import and export activities. However, there are some economic impacts in biofuel sector that need to concern. The on-going debate about social issues related to biofuel also must be discussed.

The purpose of this project is to investigate the prospects of biofuel as a green solution towards sustainability. Based on the problem statement mentioned above, the specific questions to be addressed on this study are:

- i. What are the prospects of biofuel to environment?
- ii. What are the prospects of biofuel to economy?
- iii. What are the prospects of biofuel to social?

SIGNIFICANT OF STUDY

Biofuel can consider as primary alternatives to fossil fuels for energy sources. The main focus has been on the use of alternative energy sources. Non-renewable energy sources for example conventional fuels will deplete soon. Non-renewable energy could not be reused or renewed. Alternative fuels from biological sources are emerging as a solution to the depletion of fossil fuels. Malaysia can learn from the experiences of other countries which have used biofuels.

Biofuel can reduce environmental dilemma. Biofuel will also meet with global efforts to reduce the hazardous gases for example greenhouse gases (GHG) emissions. Biofuel is environmental friendly and does not cause global warming. Biofuel can create a new demand in the market. It helps to reinforce country's position as a leading producer and exporter of biofuel. Biofuel causes some significant social phenomena which are food price volatility and increase in hunger as well as land grabbing. This can cause poverty to be displaced from their homes. However, biofuel can provide business to rural economics. This can reduce the number of poverty in the country.

Therefore, it is hope that findings gained through this study could contribute to the knowledge of government have the responsibility to design mechanisms to promote and to tap into the prospect of biofuel to the environment, economic and social.

LITERATURE REVIEW

The first form of biofuel is made from wood and used for heating and cooking very long time ago. Indeed, biofuel was discovered earlier than fossil fuels. With the discovery of electricity, human being started utilise fossil fuel such as natural gas, oil and coal. The production and use of biofuel was less concerned by the world after that.

Liquid biofuel was developed since 1700s. S. Casey was awarded the first United States (US) patent for alcohol as a lamp fuel in 1934 (Kovarik, 1998). The first combustion engine was performed with biofuels is "Otto cycle". In 1880s, the first prototype automobile can operated with ethanol as fuel. Due to economic issues, the price of petroleum became cheaper than biofuel, thus, the demand of biofuel was decreased.

During World War II, the demand of biofuel increased again due to increased use of supplementary or emergency fuels. Later, a serious oil crisis happened on 1973 and 1979. During this period, many countries started to show interest and concentration in biofuels. Brazil is the only country that can revive the bioethanol industry. After that, Brazil began to produce bioethanol and the production showed the highest rate in the world (International Energy Agency [IEA], 2004). The US overtakes the Brazilian production of bioethanol in 2006 (Renewable Fuels Association [RFA], 2011).

Still, many people are more concern about the uses of biofuels nowadays. Rising price of oil, emission of GHG and resources reason, shifts their interest to biofuels. Two kinds of biofuels are used in commercial productions which are biodiesel and bioethanol.

Environmental prospects

Biofuel is a type of renewable energy whereby the source comes from biological sources like living things or the any wastes that living things produce. It takes shorter time to produced compare to fossil fuels. Biofuels is clean than fossil fuel because it produces lesser emissions of CO₂, particulates and toxic chemicals. Biofuel has the potential of reduced environmental impacts which can reduce the GHG for example CO₂ and can help to improve domestic energy security.

Many policy makers assumed that by replacing fossil fuels with biofuel it will bring positive impacts to the environment because it will generate less emission of GHG. Biofuel when grown from plants, it can reduce the CO₂ emissions. Thus, it is able to reduce the CO₂ in atmosphere and reduce the risk of happen global warming. At least 30% of GHG can be reduced when compared with conventional fuel which is petrol (Hiorns, 2004).

By planting in appropriate areas, biofuels can contribute to reduce the climate change. Sugarcane production for ethanol could be achieved emissions savings of 80-100% and that oilseed rape for biodiesel, 20-85% greenhouse gas savings can be achieved (Howarth, Bringezu, Bekunda & Fraiture, 2008).

From the perspective of life cycle analysis (LCA), biofuel production produces more energy than the fossil energy. The use of biofuel become more sustainable, however not all production of biofuel have the potential to reduce the GHG emissions. Different type of biofuel will has different level of GHG balances when compared with

conventional fuels and some plants can generate more GHG than conventional fuels (Wiebe et al., 2008).

It is essential to make sure that food and water shortages, high food prices, deforestation as well as other ecological damages should be abolished. This is because, when one of these problems happened, it will bring big effect on environment and ecology. The indirect Land Use Change (iLUC) is one of the issues should be discussed. When the demand of biofuels increase, the land required for cultivation also increased. It can lead to soil erosion and pollution. Biofuels cultivations bring negative effects on biodiversity (Fargione, Plevin & Hill, 2009). These impacts included disappearance of some species, change in species populations and change in ecosystem diversity. It can cause land use changes and it brings many challenges to the environmental sustainability of bioenergy. For instances, it will bring implications to the food price, deforestation as well as increase the competition for land and water. Deforestation will effect to soil erosion, global warming and loss of habitat.

Economic prospects

Biofuel production in developing countries can be economically beneficial thru raise and diversify farm income as well as increase rural employment. What is more, by producing biofuel, it can increase market opportunities and to promote the capacity building. These positive impacts can bring benefits to the smallholder farmers to obtain extra income from energy crops. Under certain situations, biofuel can generate positive economic benefits to rural societies by improving the infrastructure, employment, increasing the land value and obtaining income from smallholder farming (World Bank, 2010). Significant income was brought to the land owners by producing soybean and it generated positive economic in the downstream food manufacturing (Goldsmith & Hirsch, 2006). Also, Overseas Development Institute stated that, biofuel can help to reduce the poverty in a nation through increase the employees, stabilise the oil prices and broader economic growth and by stabilising oil prices (Leturque & Wiggins, 2009). By reducing the poverty, this can boost economic growth rates.

Social prospects

By producing biofuel, it might bring social impacts in developing countries which regarding to food scarcity, displacement of communities, economic activities, deforestation and tenure arrangements (Sala et al., 2000). It has interconnection between biofuels and the prices of both food and energy (Rajagopal & Zilberman, 2007). The effect of producing biofuel from food crops will cause higher on food prices. Although biofuel might reduce the poverty in many developing countries and to improve rural development, however, there are still many social and economic concerns connected with the growing biofuel sector.

METHODOLOGY

This study employed a quantitative method. As shown in Figure 1, there are two categories of data collection which is primary data and secondary data. Primary data, also identified as raw data, is data collected by the researcher for a specific objective. Secondary data is data gathered by someone for specific objective. The reason of using qualitative research method is because it can use to find out people's attitudes, expressions and ideas. They can express their own idea and thought to the interviewers.

Therefore, interviewers can understand the feelings, perceptions and values of that project. What is more, by using qualitative research method, many extra information and knowledge can be explored through asking open ended questions.

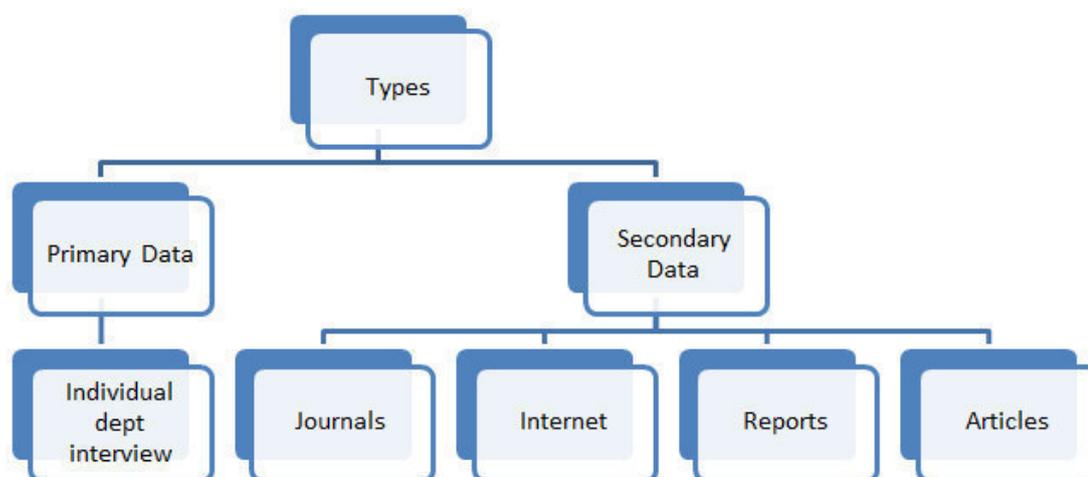


Figure 1
Classification of data

Data was collected by interviewing with a practitioner in the biofuel industry about the prospect of biofuel to the economic, social and environmental perspectives. The interview was conducted on 21st October 2016 at 5pm in Ipoh. It took about one and a half hours to conduct this interview. By using this method, a set of questions about the prospect of biofuel will be prepared to ask the interviewees' opinions. After that, data and information can be collected. This study will conduct structure interview and unstructured interview method to collect data. Information was gain through journal, internet reports and articles to accomplish this study.

FINDINGS

The findings of this quantitative study were carried out in Ipoh by using interview method with practitioner in the biofuel industry. The respondent involved was labeled as Respondent 1 (R1).

Environment prospect

The R1 revealed that biofuel is environmental friendly. This is because the combustion using fossil fuel severe greenhouse effect and cause air pollution. Biofuel helps to reduce GHG up to much extent by emitting less pollution. However, some sources can generate more GHG than fossil fuel. This is depends on the types of crop, location and how feedstock production and fuel processing are carried out.

At present, plant oil is the main source for the production of biodiesel. The research on production of biodiesel from feedstock especially insects is still insignificant. This is still a new field and has yet great potential and worth to be explored. Though it is argue to bio-ethical issues, many claimed that this action is inhuman as insects have to be killed in order to produce biodiesel. This can affect the ecological balance. However, realising the over-population and over-consumption of fuel in the future, such research

has to be continued to meet the fuel demand and it can be considered as one of the best possible solutions to reduce the dependency on non-renewable fossil fuels.

Biofuels are extracted from plants and crops that have high levels of sugar in them. However, most of these crops are also used as food crops. Even though waste material from plants can be used as raw material, the requirement for such food crops will still exist. It will take up agricultural space from other crops, which can affect biodiversity of an ecosystem.

Economy prospect

The R1 explained that the growth of biofuel in Malaysia is definitely larger than in Singapore. This is because there are still a lot of empty lands to be developed to build a biofuel industry. However, the biotechnology in Malaysia still in development stage, more researches and studies are needed to make biofuel cost-competitive with fossil fuels. The production of biofuel is a must in next twenty years in order to cover Malaysian fuel usage.

In addition, the interviewer explains that the existing and new biofuel industries can as a catalyst for economy growth especially for development country for example Malaysia. This is because biofuel has great potential to replace fossil fuel. If more people starting to shift towards biofuels, a country can reduce its dependence on fossil fuels.

Social prospect

The R1 stated that, by using biofuel, it can help to create job opportunity to the society. Therefore, living standard can be increased. People can obtain job opportunities in manufacturing sectors which are manufacture oil of fats, oil palm estates, chemicals, petrol and coal.

What is more, the importance of biofuel encourages more research in finding alternative source for biofuel. This is because, fossil fuel is going to deplete in the next 50 years. Biofuel is an alternative fuel sources to replace the fossil fuel. Therefore, biofuel technology should be improved in order to meet the fuel demand.

Biofuel can produce easily in short time whereas fossil fuel takes millions year to produce in the earth. Therefore, biofuel has potential as a sustainable energy replacement to fossil fuel. Biofuel is cleaner gases compare to fossil fuels. Burning of biofuel emits less greenhouse gases. In addition, it can avoid acid rain. The important of biofuel increase conscious of public towards environmental issue cause by the combustion of fossil fuel.

DISCUSSION

Based on the problems in this study, the research has been done to accomplish the objective goals. Therefore, the information and data was collected through interviews with the practitioner in the biofuel industry as to gain the insight about the prospects of biofuel to environmental, economic and social.

Environmental prospects

This study states that the prospects of environment to biofuel are environmental friendly and affect ecology. This study was conducted in parallel with Hiorns (2004) and Howarth et al. (2008) which is biofuel helps to reduce greenhouse gases up to much extent by emitting less pollution. Combustion of biofuel can reduce emission of CO₂ and greenhouse gases because it is offset by the CO₂ absorbed while growing the plants or other feedstock. Thus, it helps to reduce global warming problem. The use of biofuel for example biodiesel is less dangerous to the environment compare to traditional fossil fuel. Biofuel is renewable, nontoxic and biodegradable fuel. By comparing first and second generation of biofuel, the result showed that the first generation biofuel reduced greenhouse gases by 78% and second generation reduced the greenhouse gases by 94% (Highina et al., 2014). However, some sources can generate more greenhouse gases than fossil fuel. This is depends on the types of crop, location and how feedstock production and fuel processing are carried out.

What is more, Wiebe et al. (2008) and R1 has the same opinion that there are some drawbacks of using biofuel. Some of the biofuel for example using biodiesel can generate nitrogen oxides emissions which can cause acid rain. Nitrogen oxide can has more global warming than carbon dioxide.

This study shows parallel result with Fargione, Plevin & Hill (2009) and the R1 on the prospect of biofuel to the biodiversity. Biofuel is made from biomass and agricultural crops which are soy beans, palm oil and corn. The Biomass Research and Development Act 2000 explain biomass is available on plants and animal residues used for car, trucks, airplanes and trains. When the demand of biofuel increase, the land required for cultivation and animal also increased. This can bring negative impacts on wildlife and biodiversity.

Economic prospects

This study found that the prospects of biofuel in economy are parallel with the researcher Goldsmith & Hirsch (2006), World Bank (2010) and Leturque (2009). It shows positive economic impacts of biofuel which biofuel industries can contribute significantly to the economy. This study found that the prospects of biofuel in economy are parallel with the researcher Leturque (2009) and R1. It shows positive economic impacts of biofuel which biofuel industries can contribute significantly to the economy. The researcher explained that biofuel could help to reduce the poverty boost economic growth rate. The R1 said that biofuel can stimulate economy growth by remain and increase biofuel industries.

Biofuel feedstock can obtain easily and it can produce in short time compare to traditional fossil fuel. Consequently, it is reliable in supply. Nowadays, people are more depends on biofuel compare to traditional fuel. The demand of biofuel is increase. Therefore, increasing in biofuel industry can generate country's Gross Domestic Product (GDP).

Social prospects

On the other, the prospect of biofuel to the social shows non parallel result between R1 with the researcher Sala et al. (2000) and Rajagopal & Zilberman (2007). In the literature review, researchers stated that biofuel bring negative impact to the social which food scarcity occurs and causes price of foods increase. However, the

practitioner explained that, biofuel industries can create job opportunity to the people and increase their living standard. Moreover, R1 explained that biofuel can encourage more research and development (R&D) in biofuel. However, there still remains uncertainty about impacts of biofuel on environment, economy, ecological and social.

CONCLUSION

This study is to identify the prospects of biofuel as a green solution towards sustainability in term of environment, economy and social. There remains uncertainty and controversy regarding impacts of biofuel on environment, economy and social. Although biofuel is a renewable energy, still, many people argue that regarding its impacts chemicals emission, biodiversity and technology used. Although biofuel shows positive impact on social, but other aspect such as food shortage might happen. This can influence the social impact.

There are some advantages and disadvantages of using biofuel. Biofuel is very important because the natural fuel resources are in limited supply. We need to find alternative to sustain energy demand in the future.

Malaysia government should allocate huge amount of money in biofuel technology. New technology needs to be developed so that biofuels can be produced in a much easier way in the perspective of long term operation. Also, government should encourage the R&D on the high efficient technology for alternative energy production. Although the performance of biofuel is not as good as fossil fuel, however, through R&D, surely it can enhance and improve the performance of biofuel in future. The policymakers also should consider some measures as to make biofuel as feasible approach for sustainability. The controversy regarding the impact of biofuel to ecology is also a potential for future research.

To sum it up, using biofuel should be practiced and encouraged starting nowadays in order to protect the environment and safe of the earth. Environmental quality can be improved with used of biofuel.

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