

Consumer Perceptions on the Implementation of Biodiesel in the Transport Sector: A Case in the Central Region of Peninsular Malaysia

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ABSTRACT

This study analysed the level of awareness of diesel and petrol vehicle users in the central region of Peninsular Malaysia on biodiesel and the currently running biodiesel programme for the transport sector, i.e. B7. In addition, the study also examines consumer perception on the implementation of biodiesel use in the transport sector. The results suggest that the level of awareness on biodiesel and the biodiesel programme was very low. Consequently, many of the respondents were neutral in expecting any advantage from B10 on vehicle performance.

Keywords: central region, B7, B10, transport sector, biodiesel.

INTRODUCTION

Transport is closely related to daily human activities and growth of the economy. However, due to its high dependence on fossil fuel, the transport sector has become the second largest carbon contributor sector, being responsible for about 23% of global CO₂ emission in 2013 (IEA, 2015). In this regard, biofuel has been highlighted as the most promising and immediate alternative to counter the carbon emission issue (Lim and Lee, 2012). This is probably due to the fact that the current blended biofuel can be used directly in

conventional engines without major modification (Milazzo *et al.*, 2013) and that the blended biofuel can still be supplied through the existing petrol pumping facilities (Van den Hoed, 2007).

Besides the technical advantages, biofuel offers a wide range of benefits that cover political, economic, social, as well as environmental aspects. However, researchers have acknowledged that different chemical properties constitute the major technical barrier when using vegetable oils in conventional fossil fuel engines. In addition to technical barriers, the debate regarding biofuel

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usage is also extended to the environment, economic and social welfare domain. These include deforestation, loss of biodiversity, haze (air pollution), increase in carbon emission when land use change is considered, increase in nitrogen and particulate emissions, a huge amount of water usage, extremely high energy usage, food *versus* fuel, rural poverty and land use conflict (Chin *et al.*, 2014). Collectively, these issues emerge as a strong barrier against biofuel development.

Malaysia has embarked on biofuel research, in particular palm-based biodiesel, since 1982 (Chin, *et al.*, 2014). As the second largest oil palm producer in the world, Malaysia enjoys an advantage of having a vast oil palm planted area, which in turn can ensure a continuous supply of the raw material for biodiesel production. In 2015, 5.64 million hectares were planted with oil palm in Malaysia. Of this area, 4.86 million hectares or 86% of the total planted area were mature palms (MPOB, 2016). These in turn produced 19.96 million tonnes of crude palm oil in the year 2015 (MPOB, 2016). It is expected that the Malaysian oil palm area will continue to grow in the future; consequently, crude palm oil production is expected to rise. This partly explains why palm oil is being highlighted by Malaysia as feedstock for biodiesel production.

In terms of technological advantage, Malaysia has relatively mature technologies in the oil palm sector. Malaysia has proven herself as being at the frontline for palm-based biodiesel with the successful invention of two biodiesel products: a summer and a winter palm biodiesel product. The summer grade of biodiesel products has a pour point at 15°C while the winter grade can be sustained at temperatures as low

as -20°C without causing clogs in diesel engines (Lim and Teong, 2010; Kushairi, 2014). This palm-based biodiesel invention has been subjected to a series of field trials and road tests using government vehicles, as well as tested in other countries (Loh and Choo, 2012). The promising result obtained from road tests has encouraged the Malaysian government to set an ambitious goal to be the leading nation in palm-based biodiesel technology.

Alongside the development of palm-based biodiesel in Malaysia, several policies and programmes have been formulated. Of these policies, the National Biofuel Policy 2006 is the main one. This policy aims to promote palm-based biodiesel for export, and its usage by transport, industry and machinery equipment, as well as for environmental protection. To prevent oversupply and a low optimisation rate of biodiesel production, the Biofuel Industry Act 2007 has been enforced to strengthen the licence application for biodiesel production. In terms of charting the future directions for Malaysia's biofuel development, the National Biomass Strategy 2020 was launched. This policy delivers a future roadmap towards second-generation biofuel production from biomass, especially residues from the palm oil industry (Chin *et al.*, 2014).

Backed by innovative technology, a promising supply of palm-based feedstock, supportive policies and encouraging road test results, the former Prime Minister of Malaysia, Tun Abdullah Ahmad Badawi, officially announced the nation's first biodiesel product, Envo Diesel, on 22 March 2006, to be adopted on a voluntary basis (Abdullah *et al.*, 2009). Envo Diesel consists of 5% local refined, bleached and deodorised palm olein blended with 95%

petroleum diesel (Lim and Teong, 2010). It is believed that using palm olein (instead of palm methyl ester) to produce biodiesel reduces both production time and cost (Jayed *et al.*, 2011). Unfortunately, engine manufacturers were reluctant to support this programme (Sorda *et al.*, 2010) because they claimed that Envo Diesel can cause clogging in the engine (Jayed *et al.*, 2011). They were also unwilling to give additional warranty for diesel engines which run on Envo Diesel. This in turn caused the Malaysian government to stop the Envo Diesel Programme.

As an alternative, Malaysia has replaced palm olein with palm methyl ester, starting in February 2009. More than 3900 vehicles from various government agencies such as Kuala Lumpur City Hall (DBKL) and the Armed Forces conducted test usage of the fuel with no report of adverse effects (Asian Automotive News, 2011). The programme is known as the B5 Biodiesel Programme which makes it mandatory to blend 5% palm methyl ester with 95% petroleum diesel. However, the acceptance issue among engine manufacturers has not been resolved with the substitution of this more favourable blended biodiesel; indeed, the acceptance issue emerged from oil companies because they were concerned about their company profit if the biodiesel engine is sold instead of the petroleum diesel version (Ong *et al.*, 2011). For instance, as of 24 March 2009, palm-based biodiesel was sold at RM 2.80/litre while petroleum diesel sold at RM 1.70/litre (Mekhilef *et al.*, 2011). Oil companies are concerned that this high purchase price will discourage customers from buying biodiesel which will in turn influence their financial performance. In order to address this issue, the Malaysian government has agreed to subsidise

the price of B5 biodiesel. The official launch of the B5 Biodiesel programme then took place on 1 June 2011 (Choo, 2015). Following the provision subsidies from the Malaysian government, B5 biodiesel was sold at a price similar to that of petroleum diesel. Beginning from March 2014, the B5 Biodiesel Programme has been fully implemented in Peninsular Malaysia for the subsidised sector. Total palm oil consumption for the B5 Programme in Peninsular Malaysia involving the subsidised sector is estimated at 300 000 t per annum (Choo, 2015).

The government has moved forward to implement the B7 Programme. The programme was started in November 2014 in Peninsular Malaysia, and was then extended to Sabah and Sarawak in stages beginning in December 2014. Currently, B7 is sold at all pump stations in Peninsular Malaysia to replace B5 biodiesel. Total palm oil required for the B7 Programme involving all the subsidised sectors in Peninsular Malaysia, Sabah and Sarawak is estimated at 575 000 t annually (Choo, 2015).

At present, Malaysia plans to implement the B10 Programme in 2016 (The Star, 2016). However, industry has been encouraged to use B10 on a voluntary basis through an incentive scheme offered to them since 2013. A recent development in the B10 Programme shows that a provisional Malaysian Standard for B10 has been developed and approved. In order to facilitate the implementation of B10 and enable the provisional Malaysian Standard to be accepted as a full standard, a B10 sub-working group led by MPOB has been established and is undertaking studies on B10. In addition, Mercedes Benz Malaysia has announced that its diesel-powered vehicles are fully compatible with B10 (The Sun Daily, 2015).

From this account, it is noticed that issues relating to social acceptance had caused the cancellation of the Envo Diesel programme due to lack of acceptance by engine manufacturers. Later, they also caused the delay in the implementation of B5 due to concerns over its impact on profit by oil companies. From the example of Malaysia, social acceptance can be regarded as a continuing issue which can only be solved when it is fully understood.

LITERATURE REVIEW

There are several empirical studies on consumer preference for biodiesel. Zhang *et al.* (2011) studied the awareness and attitudes towards biofuels and views on policies among 374 private vehicle drivers (owners) in Nanjing, China. The study found that the majority of the respondents were not well-informed about biofuel implementation and the emphasis on the significance of biodiesel in reducing GHG emissions, in improving energy security and in mitigating the energy crisis. However, half of the respondents believed that biofuel technology was still not mature. The study also indicates that there was a difference in perception regarding biofuels between passenger vehicle drivers (PVD) and freight vehicle drivers (FVD). The former focused on fuel price and fuel performance, and concentrated on fuel-related attributes, while the latter paid more attention to fuel availability and focused on policy-related factors.

In the same vein, Johnson *et al.* (2013) studied the awareness, use and perceptions of biodiesel among 134 fuel customers at three north-western Arkansas retail fuel outlets. The study indicates that the majority of the customers were

aware of biodiesel; however, only 6.7% had ever purchased biodiesel. A large number of the respondents were uncertain of biodiesel quality, performance, and its effects on engine repair and maintenance. Despite these uncertainties, the majority of the respondents agreed or strongly agreed that it was better to use biodiesel because it is renewable. Respondents were almost evenly divided in their levels of agreement with the use of food crops to produce biodiesel. Sizeable percentages of consumers were undecided whether biodiesel reduced harmful exhaust emission, or whether increased biodiesel use would decrease global warming.

A similar study was conducted by Mariasiu (2013) on vehicle drivers in Romania. The study found that consumer awareness relating to biofuels was low. However, their attitudes towards biofuels were extremely favourable. The majority of the respondents who had heard about biofuels was likely to use them and would agree to their introduction for use by public transport. Respondents were found to be concerned about higher costs of use, the perceived altered vehicle engine functionality/efficiency, and accessibility to cheap biofuels. It was found that with increasing education level of the respondents, the negative perception on the use of biofuels in transport increased, especially on the potential negative effects of land use for industrial crops, the problem of 'food vs. fuel', and increased NO_x emissions (compared with fossil fuels).

Khachatryan *et al.* (2011), on the other hand, investigated the relationship between the fuel choice of consumers in USA and price, emissions, and service availability, together with a set of behavioural and socio-demographic variables. The results indicate that economic incentives, such as cheaper prices and service availability, were more

important than environmental incentives, such as reduction in environmental emission levels. The study also found that the respondents with higher levels in pro-environmental norms not only preferred ethanol to gasoline, but also preferred the environmentally cleaner alternative, *i.e.* cellulose-based ethanol. Increasing the extent by which individuals cared about the future consequences from their current actions led to an increased preference for environmentally cleaner fuels.

Meanwhile, Delshad and Raymond (2013) investigated the relationship between media framing and public opinion on the issue of biofuels in USA. In general, the results confirm that public attitudes toward biofuels appeared to be shaped by these new media frames, especially among those who indicated a high degree of attention to the media, suggesting the relative importance of framing effects on policy attitudes for environmental and energy policies in general.

While there have been some studies on the consumer perception on the use of biodiesel in the literature, studies in the Malaysian context have yet to be found.

METHODOLOGY

The data used in this analysis were obtained from face-to-face interviews with drivers/owners of diesel and petrol engine vehicles in Malaysia. The respondents represented petrol and diesel consumers over 18 years of age who were vehicle users/owners, and thus regularly purchased petrol/diesel fuel. We followed a quota sampling procedure, stratified by vehicle type, and the respondents were selected randomly. To determine sample number, the total number of diesel vehicles registered in

Malaysia stratified by the type of vehicle was used.

The sample size was determined based on Yamane's (1967) formula:

$$n = N / \{1 + N (1-e)^2\}$$

where:

n = sample size;

N = size of population; and

e = degree of confidence.

A pilot survey was conducted on 28 May 2015 on 20 respondents at the Shell petrol station at the southbound Seremban PLUS rest and service area. The actual survey was conducted over two months, from 1 July to 28 August 2015, at 50 randomly selected petrol stations nationwide. A random selection was made (with the aid of Microsoft Excel) from the full list of petrol stations associated with the five major oil companies in Malaysia (*i.e.* Petronas, Shell, Petron, Caltex and BH Petrol) which was provided by the respective oil companies. The list of selected petrol stations then was returned to the respective oil companies together with information on the proposed date of survey and the enumerator involved. The detailed information and instructions to allow the survey were then conveyed from the oil companies to the selected petrol stations. In order to avoid problems in getting permission from the selected petrol stations during the scheduled survey, follow-up calls to the respective stations were made by the research team prior to the scheduled survey date to ensure that the operator of the petrol stations were aware of the survey programme.

A total of 380 respondents participated in the interviews, with 20 respondents randomly selected at each petrol station for each interview session. Face-to-face interviews were carried out between July and August 2015 on 225 diesel users and 155 petrol

users in Kuala Lumpur (at four petrol stations), Selangor (10 petrol stations), Negeri Sembilan (two petrol stations) and Melaka (two petrol stations). The interviews were conducted by experienced and well-briefed enumerators, selected from among the Malaysian Palm Oil Board and Universiti Kebangsaan Malaysia research assistants. For each session, the interviews were conducted on working days, between 8.00 am and 5.00 pm, with a half-hour interval between interviews. In order to avoid any misconduct/fraud by enumerators, a pre-prepared certificate of survey conduct with endorsement from the petrol station was awarded to the enumerators, to be returned to the research team as a proof that the survey had actually been conducted as per instructions. The enumerators were also asked to take pictures (with permission from the petrol stations) during the interview sessions for record keeping. The completed questionnaires were then transferred by the enumerators to the online survey form after the completion of each session. This was to ensure that every question had been asked of and answered by the respondents.

EMPIRICAL RESULTS

Profile of the Respondents

The study found that most of the respondents were Malay, male and aged below 40 years (*Table 1*). In terms of education level, most had completed secondary education. The study also found that the majority of the respondents worked for the private sector and earned between RM 2000 and RM 5000. In addition, most of them were found to be lorry owners/drivers (for diesel users) and motorcyclists (for petrol users).

TABLE 1. PROFILE OF RESPONDENTS

Item	Petrol (%)	Diesel (%)	Item	Petrol (%)	Diesel (%)
Gender			Employment (sector)		
Male	60.3	96.4	Government	16.1	2.7
Female	39.7	3.6	Private	41.3	66.7
			Self-employed	22.6	25.8
Race			Housewife	6.5	0.4
Malay	80.6	64.4	Pensioner	6.5	1.8
Chinese	11.6	15.1	Student	6.5	0.4
Indian	7.7	20.0	Others	0.6	2.2
Others	0.0	0.4			
			Level of income (RM)		
Age (yr)			<2 000	32.9	28.4
<20	2.6	0.0	2 000-4 999	46.5	52.0
20-29	29.0	20.4	5 000-7 999	14.2	12.9
30-39	25.8	28.9	8 000-10 999	3.9	4.0
40-49	16.8	32.4	11 000-13 999	1.9	1.8
50-59	16.8	13.3	> 14 000	0.6	0.9
>60	9.0	4.9			
			Type of vehicle		
Level of education			Motorcycle	24.5	0.0
Primary school	8.4	19.1	Car/van	73.5	11.1
PMR/SRP/LCE	9.0	19.6	Taxi	1.3	0.0
SPM/MCE	35.5	37.8	4WD	0.6	22.2
STPM/HSC	23.2	15.1	Lorry	0.0	65.3
Degree	20.0	5.3	Bus	0.0	1.3
Master/Ph.D	3.9	3.1	Tractor	0.0	0.0

Note: PMR - *Penilaian Menengah Rendah*. SRP - *Sijil Rendah Pelajaran*.
LCE - Lower Certificate of Education. SPM - *Sijil Pelajaran Malaysia*.
MCE - Malaysian Certificate of Education. STPM - *Sijil Tinggi Pelajaran Malaysia*. HSC - Higher School Certificate.

Knowledge about Biodiesel

In general, the study found that there were some similarities in terms of knowledge about biodiesel between petrol and diesel users (Table 2). Respondents perceived diesel (biodiesel) at the pump to be good quality diesel. In terms of awareness, the majority of them stated that they were aware of or had heard about biodiesel but were not aware of the existence of the B7 Programme. However, the study shows that the respondents did not truly understand the composition of biodiesel blends, and were also not aware that diesel at the pump was biodiesel. Nevertheless, they agreed that biodiesel is an environmental-friendly fuel.

Willingness to Pay for Biodiesel

The majority of the respondents were not willing to pay premium price for biodiesel (Figure 1). However, most of them could accept biodiesel if it were sold at the same price as petroleum diesel. Nevertheless, a few of them would only be willing to pay for biodiesel

if it was cheaper than petroleum diesel.

Expectations of B10 on Vehicle Performance

The study found that many of the respondents were neutral in anticipating the effect of B10 on vehicle performance (Table 3).

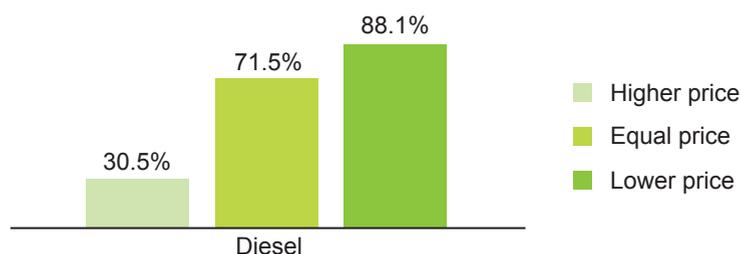


Figure 1. Willingness to pay for biodiesel at prices relative to that of petroleum diesel.

TABLE 2. RESPONDENTS' KNOWLEDGE ON BIODIESEL

Knowledge about biodiesel	Petrol			Diesel		
	Yes (%)	No (%)	Not sure (%)	Yes (%)	No (%)	Not sure (%)
Aware of biodiesel	94 (60.6)	51 (32.9)	10 (6.5)	115 (51.1)	102 (45.3)	8 (3.6)
Aware of B7 Programme	23 (14.8)	119 (76.8)	13 (8.4)	24 (10.7)	191 (84.9)	10 (4.4)
Biodiesel B7 is a blend of biodiesel and petroleum diesel	29 (18.7)	3 (1.9)	123 (79.4)	23 (10.2)	2 (0.9)	200 (88.9)
Aware that diesel at pump is biodiesel	48 (31.0)	90 (58.1)	17 (11.0)	71 (31.6)	136 (60.4)	18 (8.0)
Aware that biodiesel is environmental-friendly	76 (49.0)	50 (32.3)	29 (18.7)	100 (44.4)	63 (28.0)	62 (27.6)

TABLE 3. EXPECTATIONS OF B10

Expectation of B10	Petrol			Diesel		
	Not agree (%)	Neutral (%)	Agree (%)	Not agree (%)	Neutral (%)	Agree (%)
More power to engine	11 (7.1)	73 (47.1)	71 (45.8)	28 (12.9)	93 (41.3)	103 (45.7)
More pick up to the vehicle	13 (8.3)	72 (46.5)	70 (45.1)	30 (13.4)	89 (39.6)	106 (47.1)
Less noise	11 (7.1)	70 (45.2)	74 (47.8)	29 (12.9)	89 (39.6)	107 (47.6)
No engine jerks	13 (8.3)	72 (46.5)	70 (45.2)	30 (13.3)	91 (40.40)	104 (46.2)
Less engine maintenance and service	14 (9.0)	72 (46.5)	69 (44.5)	36 (16.0)	95 (42.4)	110 (41.8)
Less spare parts replacement	13 (8.4)	73 (47.1)	69 (44.5)	35 (15.5)	93 (41.3)	97 (43.1)
Engine temperature is lower	17 (10.9)	72 (46.5)	66 (42.6)	28 (12.4)	94 (41.8)	103 (45.8)
Less tailpipe emission	10 (6.5)	58 (37.4)	87 (56.2)	19 (8.4)	78 (34.7)	128 (56.9)
Lower fuel consumption	8 (5.2)	72 (46.5)	75 (48.3)	19 (8.4)	92 (40.9)	114 (50.6)
No adverse effects on the engine	9 (5.8)	79 (51.0)	67 (43.3)	22 (9.7)	89 (39.6)	114 (50.7)
Suitable for his/her vehicle	33 (21.2)	73 (47.1)	49 (31.7)	19 (8.5)	71 (31.6)	135 (60.0)
Agree to replace B7 with B10	7 (8.9)	52 (33.5)	96 (61.9)	20 (8.9)	50 (22.2)	155 (68.9)

About 32%-42% of the diesel users and 34%-50% of the petrol users chose not to agree or disagree with the statements. Overall, 43%-69% of the diesel users indicated a high expectation on B10, whereas for the petrol users it was 32%-61%. The majority of the respondents expected that B10 will give less tailpipe emissions. Most of the diesel users also expected that B10 will lower their fuel consumption, will not have adverse effects on their engine, and is suitable for

their vehicle. About two-third of the respondents agreed to replacing B7 with B10.

CONCLUSION

The study found that consumers' understanding of biodiesel is very low. Consumers are not aware of the various biodiesel programmes, especially the B7 Programme; therefore, they are not aware that they have been using biodiesel for

their vehicle. This study also found that many of the respondents are neutral in expecting an effect of B10 on vehicle performance. This is very understandable because they are not aware of it. Therefore, it is very important for the government to increase consumer awareness, especially on the effect of using biodiesel B10 on vehicle performance before implementing the programme in the transport sector.

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