Structural Equation Modeling of Motorcycle Biofuels Consumption in Nakhon Ratchasima Province: Gasohol 91 and Gasohol E20

การวิเคราะห์แบบจำลองสมการโครงสร้างการใช้พลังงานเชื้อเพลิงชีวภาพในรถจักรยานยนต์ในจังหวัดนครราชสีมา: แก๊สโซฮอล์ 91 และแก๊สโซฮอล์ E20

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ABSTRACT

The objective of this research was to study factors affecting gasohol 91 and gasohol E20 consumption of motorcycles. The sample consisted of 1,020 motorcyclists in Muang District, Nakhon Ratchasima Province, that is divided into 510 gasohol 91 users and 510 gasohol E20 users. The data was analyzed by Structural Equation Modeling. According to gasohol 91 consumption, the results indicated that the final model was fit the empirical data with CMIN/DF = 2.204, IFI = 0.972, TLI = 0.970, CFI = 0.972, RMSEA = 0.049, and HOELTER = 246. The factors affecting gasohol 91 consumption prioritized in order from highest to lowest are as follows: gas station, information, alternative assessment, satisfaction, price, purchase decision, and public relations. Furthermore, all factors described the variance of gasohol 91 consumption was approximately 83.40 percent. For gasohol E20, the findings showed that the final model was fit the empirical data with CMIN/DF = 2.201, IFI = 0.970, TLI = 0.968, CFI = 0.970, RMSEA = 0.049, and HOELTER = 244. The factors affecting gasohol E20 consumption prioritized in order from highest to lowest are as follows: gas station, alternative assessment, price, public relations, satisfaction, purchase decision, and information. Furthermore, all factors described the variance of gasohol E20 consumption was approximately 86.30 percent.

KEYWORDS: Structural Equation Modeling, Gasohol 91, Gasohol E20, Motorcycle

บทคัดย่อ

การวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาปัจจัยที่ส่งผลต่อการใช้น้ำมันแก๊สโซฮอล์ 91 และแก๊สโซฮอล์ E20 สำหรับรถจักรยานยนต์ กลุ่มตัวอย่างที่ใช้ในการศึกษา คือ ผู้ขับขี่รถจักรยานยนต์ในเขตอำเภอเมือง จังหวัดนครราชสีมา จำนวน 1,020 คน ซึ่งแบ่งออกเป็นผู้ใช้น้ำมันแก๊สโซฮอล์ 91 จำนวน 510 คน และผู้ใช้น้ำมันแก๊สโซฮอล์ E20 จำนวน 510 คน ทำการวิเคราะห์ข้อมูลโดยใช้การวิเคราะห์แบบจำลองสมการโครงสร้าง ผลการวิจัยสำหรับน้ำมันแก๊สโซฮอล์ 91 พบว่า แบบจำลองสมการโครงสร้างสุดท้ายมีความสอดคล้องกลมกลืนกับข้อมูลเชิงประจักษ์ (CMIN/DF = 2.204, IFI = 0.972, TLI = 0.970, CFI = 0.972, RMSEA = 0.049, and HOELTER = 246) ปัจจัยที่ส่งผลต่อการใช้น้ำมันแก๊สโซฮอล์ 91 เรียงลำดับจากมากที่สุดไปหาน้อยที่สุด ได้แก่ ปัจจัยด้านสถานีบริการน้ำมัน ปัจจัยด้านข้อมูลข่าวสาร ปัจจัยด้านการประเมินผลทางเลือก ปัจจัยด้านความพึงพอใจ ปัจจัยด้านราคา ปัจจัยด้านการตัดสินใจซื้อ และปัจจัยด้านการประชาสัมพันธ์ โดยปัจจัยทั้งหมดสามารถอธิบายความแปรปรวนของการใช้น้ำมันแก๊สโซฮอล์ 91 ได้ร้อยละ 83.40 สำหรับน้ำมันแก๊สโซฮอล์ E20 ผลการวิจัยพบว่า แบบจำลองสมการโครงสร้างสุดท้ายมีความสอดคล้องกลมกลืนกับข้อมูลเชิงประจักษ์ (CMIN/DF = 2.201, IFI = 0.970, TLI = 0.968, CFI = 0.970, RMSEA = 0.049, and HOELTER = 244) ปัจจัยที่ส่งผลต่อการใช้น้ำมันแก๊สโซฮอล์ E20 เรียงลำดับจากมากที่สุดไปหาน้อยที่สุด ได้แก่ ปัจจัยด้านสถานีบริการน้ำมัน ปัจจัยด้านการประเมินผลทางเลือก ปัจจัยด้านราคา ปัจจัยด้านการประชาสัมพันธ์ ปัจจัยด้านความพึงพอใจ ปัจจัยด้านการตัดสินใจซื้อ และปัจจัยด้านข้อมูลข่าวสาร โดยปัจจัยทั้งหมดสามารถอธิบายความแปรปรวนของการใช้น้ำมันแก๊สโซฮอล์ E20 ได้ร้อยละ 86.30

คำสำคัญ: การวิเคราะห์แบบจำลองสมการโครงสร้าง แก๊สโซฮอล์ 91 แก๊สโซฮอล์ E20 รถจักรยานยนต์

Introduction

The Royal Chitralada Project on gasohol production has been initiated since 1985. The project reflects from intelligence, hard work, and determination of King Bhumibol Adulyadej or King Rama IX. The king has invested in the fuel research for the proper choice suitable in Thailand for long time. So, people can have high quality products on the basis of the substantial price (Ministry of Energy, Energy Policy and Planning Office, n.d.). Gasohol is produced from gasoline and ethanol that can be replaced by the Methyl Tertiary Butyl Ether (MTBE) that needs to be imported from foreign countries. Ethanol can be produced from agricultural crops such as sugar cane, corn, and cassava, etc., which are abundantly available in Thailand. Presently, there are four types of gasohol products in the market, i.e. gasohol 91, gasohol 95, gasohol E20, and gasohol E85.

According to the oil management plan in 2015-2036, the consumption rate of ethanol is targeted at 11.30 million litres per day in 2036. In 2015, the consumption rate was only 3.50 million litres per day (Ministry of Energy, Department of Energy Business, 2015) that was far behind target. Also, the

government plans to cancel gasohol 91 distribution on January 1, 2018, and cancel gasohol 95 distribution in 2027. In 2036, there will distribute only two types of gasohol: gasohol E20 and E85. But now there are all types of gasohol sale. Furthermore, there is the plan to set price difference of each gasohol type to attract car users to use gasohol. From oil prices during September – December 2017, it was found that the retail price difference between gasohol 91 and gasohol E20 was about 2.24 baht per litres and between gasohol 95 and gasohol E20 was about 2.51 baht per litres (Ministry of Energy, Energy Policy and Planning Office, 2017). The statistical record on the consumption of gasohol in Thailand between 2007 – 2016 showed that the consumption of gasohol 91 and gasohol 95 (low ethanol proportion group) are in larger quantity than gasohol E20 and gasohol E85 (high ethanol proportion group) (National Statistical Office, n.d.) as shown in Figure 1. As seen, the retail price of gasohol E20 is close to gasohol 91 and gasohol 95. That results in car users choose to use gasohol 91 and gasohol 95 more than gasohol E20.

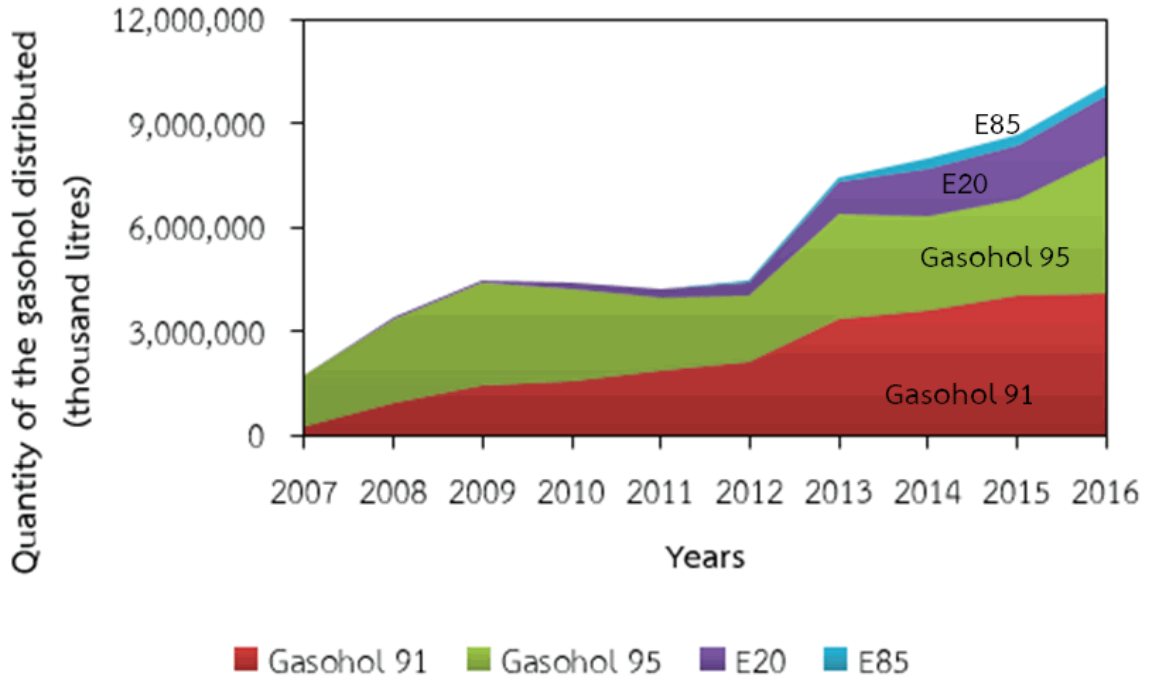

Figure 1 The quantity of the gasohol distributed in Thailand in 2007-2016
Source: National Statistical Office (n.d.)

Nakhon Ratchasima province is the large city with a large volume of the fuel consumption rate, as the growth of the economic rise. According to the accumulation of the registered motorcycles, 712,805 vehicles or 57.14% of the automobiles in the province were registered that is the largest number in the Northeastern region of Thailand (Ministry of Transport, Department of Land Transport, 2017). Because motorcycles are flexible in daily used and also the price is less than the car price, the quantity of the motorcycles keep rising more and more in each year.

For increasing the consumption of the renewable energy for biofuel in the ethanol part in Thailand according to the target planning in 2036, there are needs especially the cooperation of all ethanol users. Also, there are needs to build up the recognition and to lower the rejection of biofuel uses in the future. Therefore, the research on the topic of factors influencing the consumption of biofuels in motorcycles is necessary because of an increase in large number of the registered motorcycles in each year. The study needs to cover both low and high ethanol proportion groups to accord with current usage. This paper focuses on low ethanol proportion group: gasohol 91 because of the highest consumption. In high ethanol proportion group, gasohol E20 is chosen because of the low consumption, the retail price close to gasohol 91, and E20 motorcycles more than eight million (Ministry of Energy, Department of Energy Business, 2015) in order to acknowledge the decision on choosing the types of biofuel comes from factor mentioned.

Purpose

The aim of this research is to study factors that affect gasohol 91 and gasohol E20 consumption of motorcycles.

Hypothesis

The previous study on factor analysis of using biofuels for motorcycle (Tongdechasamart, Vongchavalitkul, & Khodphan, 2018) found that the factors of using biofuels for motorcycles were seven factors as follows: information (F1), price (F2), gas station (F3), public relations (F4), alternative assessment (F5), purchase decision (F6), and satisfaction (F7). Those factors could be measured by the observed variables, i.e. X1-X15, X17-X23, and X25-X45 that their explanations were shown in Appendix A. The initial structural equation model for this study can be presented in Figure 2, variable Y is gasohol consumption in litres.

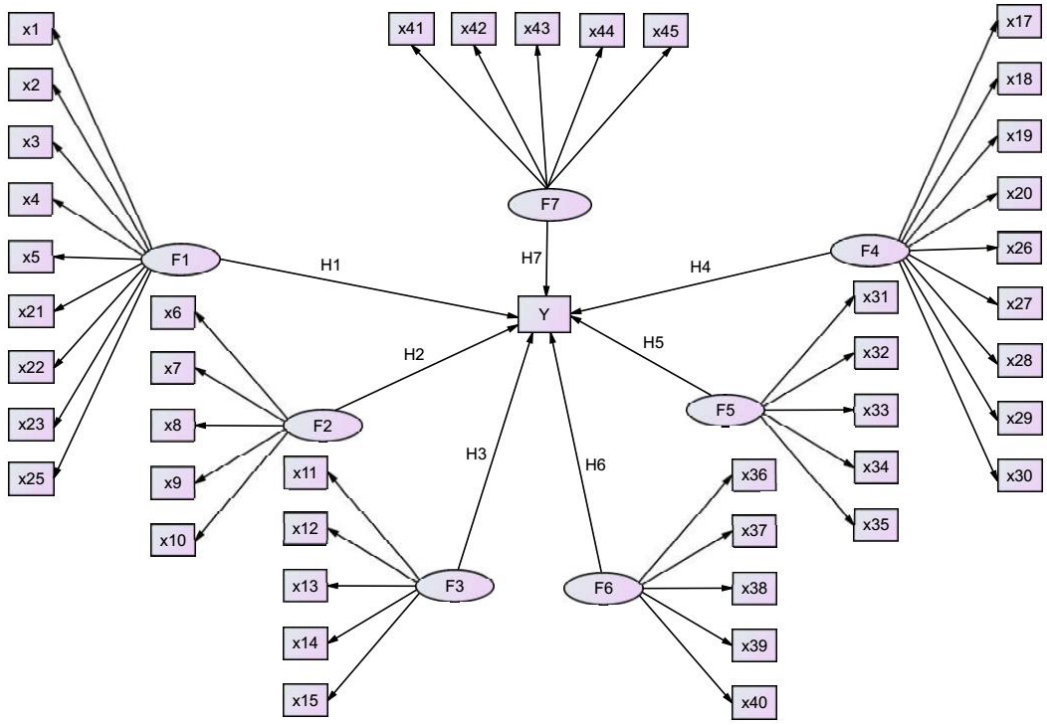

Figure 2 Initial structural equation model

The correlations in Figure 2 can be divided into seven hypotheses as follows:

H1: Information (F1) influences gasohol consumption (Y)

H2: Price (F2) influences gasohol consumption (Y)

H3: Gas station (F3) influences gasohol consumption (Y)

H4: Public relations (F4) influences gasohol consumption (Y)

H5: Alternative assessment (F5) influences gasohol consumption (Y)

H6: Purchase decision (F6) influences gasohol consumption (Y)

H7: Satisfaction (F7) influences gasohol consumption (Y)

Benefit of Research

The benefits expected from this study are to identify and understand influential factors in the biofuels consumption of gasohol 91 and E20 of motorcycles. The results of this research can suggest future direction for the research on risk management of factors affecting biofuels consumption of motorcycles. Meanwhile, the government, the Ministry of Energy or the concerned private agencies can use the results to plan and promote biofuels consumption to increase and achieve the target in 2036.

Research Process

This research is to study factors affecting biofuels consumption of the motorcycle. Gasohol 91 and gasohol E20, which are high and low consumption respectively, were used for this study. The Structural Equation Modeling (SEM) was used in the analysis to investigate the factors affecting biofuels consumption and to test the hypotheses.

Population and Sample

The population of this research was the motorcyclists who used gasohol 91 or gasohol E20 as fuel in Muang District, Nakhon Ratchasima Province. The analysis with the Structural Equation Modeling should have the sample size at least 100-200 (Boomsma, 1985; Kline, 1998; Loehlin, 1998) or at least 5 to 10 times of the number of variables (Bentler & Chou, 1987; Bollen, 1989; Hair, Black, Babin, & Anderson, 2010; Kline, 1998; Nunnally, 1967; Schumacher & Lomax, 2010). In this research, there were 44 observed variables (X1-X15, X17-X23, X25-X45, Y) in Figure 2. To protect errors and to increase reliability, the sample size of this research was 510 sample per each fuel type. The purposive sampling was used to select top six areas in Muang District, Nakhon Ratchasima Province, that have the most people for collecting data (25 percent of the administrative district) as follows: Nai Muang Sub-district, Cho Ho Sub-district, Pho Klang Sub-district, Hua Thale Sub-district, Nong Bua Sala Sub-district, and Khok Kruat Sub-district. Furthermore, the convenience sampling technique was used to collect data from each Sub-district of 85 samples per fuel type. Data was collected during September-December 2017.

Instruments

The measurement instrument of this research was questionnaire based on the results of the previous study on factor analysis of using biofuels of motorcycles (Tongdechasamart et al., 2018). The items of questionnaire were prepared from literature review and research related to marketing mix including product, price, place, and promotion, consumer behavior, and consumer's buying decision process including problem recognition, information search, evaluation of alternatives, purchase decision, and post-purchase behavior. Those are very important for consumer's buying decisions (Chakatit, 2013; Kotler, 2002; Kuwatanavanit, 2013; Lertharn, 2009; Lilarungrot, 2016; Putsom, 2011; Serirat, 2007; Wachirakomen & Ativetin, 2015). The items of the questionnaire that used for each construction presented in Appendix A. A five-point Likert scale (5 = most influencing, 4 = much influencing, 3 = moderate influencing, 2 = less influencing, and 1 = least influencing) was adopted in order to answer each item.

The measurement instrument was checked for its content validity by three experts in their respective fields based on the item-objective congruence (IOC) index.

The IOC index of each item was between 0.67-1.00 (higher than 0.50 was acceptable (Chakatit, 2013)). In order to test the reliability of the questionnaire, the questionnaire was tried out by 40 motorcyclists who are not the sample. The reliability value was checked by using Cronbach's alpha coefficient. The Cronbach's alpha coefficient indicated alpha of 0.96 (higher than 0.70 was acceptable (Vanichbuncha, 2014)).

Data Analysis

The Structural Equation Modeling is an advanced statistical tool for analyzing the relationships among different types of variables. It can deal with unobserved latent variables that are expressed by linear combinations of the measured indicator variables. It consists of combination of multivariate statistical techniques such as Multiple Regression Analysis (MRA) and Factor Analysis (FA). A structural equation model contains two models as follows: measurement model and structural model, which can be estimated simultaneously. A measurement model indicates the relations between observed variables and latent variables by using Confirmatory Factor Analysis (CFA). A structural model indicates the causal relations of latent variables among themselves by using Multiple Regression Analysis. A measurement model and structural model can be evaluated in a single model (Kovacic, Topolsek, & Dragan, 2015).

This research used the Structural Equation Modeling as a tool to find factors affecting gasohol 91 and gasohol E20 consumption of a motorcycle. The initial structural equation model in Figure 2 was analyzed by using AMOS. The Maximum Likelihood (ML) was used for the estimation of model parameters and assumed for multivariate normal distribution. Several indices were used to evaluate overall model fitness as follows:

1. Relative chi-square (CMIN/DF) should be less than or equal to 3 (Kline, 1998; Ma, Pi, Dong, & Chen, 2017; Mueller, 1996).

2. Incremental Fit Index (IFI) should be greater than or equal to 0.90 (Mai & Ness, 2006; Vanichbuncha, 2014).

3. Comparative Fit Index (CFI) should be greater than or equal to 0.90 (Mai & Ness, 2006; Vanichbuncha, 2014).

4. Tucker-Lewis Index (TLI) should be greater than or equal to 0.90 (Mai & Ness, 2006; Schumacher & Lomax, 2010; Vanichbuncha, 2014).

5. Root Mean Square Error of Approximation (RMSEA) should be less than or equal to 0.05 (Schumacher & Lomax, 2010).

These mean that the model provides a reasonably good fit to the empirical data.

6. HOELTER Index is used to judge if the sample size is adequate. It should be greater than 200 (Vanichbuncha, 2014).

Reliability and validity of construction were evaluated to establish the strengths of the final SEM. The reliability testing based on Cronbach's alpha coefficient was performed by using SPSS and Composite Reliability (CR). The acceptable level of Cronbach's alpha coefficient should be greater than 0.70 (Doloi, Iyer, & Sawhney, 2011; Doloi, Sawhney, & Iyer, 2012) and CR should be greater than 0.70 (Hair et al., 2010; Ma et al., 2017). Convergent validity was evaluated from the standardized loadings of the measurement models in the final SEM analysis and Average Variance Extracted (AVE). The acceptable level of the standardized loadings should not be less than 0.50 but a threshold of 0.70 has been widely used as an acceptable level (Doloi et al., 2011; Doloi et al., 2012; Hair et al., 2010) and AVE should be greater than 0.50 (Hair et al., 2010; Ma et al., 2017). The observed variables with low loadings should be considered for elimination. Furthermore, discriminant validity was assessed from cross-loadings analysis by using SPSS. For cross-loadings analysis, the factor loading indicators on the assigned construct had to be higher than all loading of other constructs (Ab Hamid, Sami, & Mohmad Sidek, 2017; Doloi et al., 2011; Doloi et al., 2012). Reliability and validity of construction for the final model were reported in the results of research.

The hypothesis test considered from the level of significance (p-value) and the Critical Ratio must be less than 0.05 and greater than 1.96, respectively (Santos Neto, Dantas, & Machado, 2017).

Results and Discussion

The results indicated as follows:

1. Gasohol 91

Referring to data collected from the sample who used gasohol 91, it showed that the mean of each item related to the factors of using biofuels of motorcycles ranged from 3.36 to 4.11, and the standard deviation ranged from 0.516 to 1.072. The mean and the standard deviation of gasohol 91 consumption were 26.438 litres and 11.342 litres, respectively. In addition, the normality test of variables was done by using SPSS. The absolute values of Skewness Index (SI) were less than 2 and the absolute values of Kurtosis Index (KI) were less than 7, that were supported at the acceptable level for normal distribution (Curran, West, & Finch, 1996). Thus, the distribution of variables was the normal and appropriate to use ML estimator in SEM analysis.

According to the results of the initial SEM analysis and model refinements, it was found that a total of four observed variables as X7, X23, X35, and X37 was eliminated due to their low standardized loadings (< 0.50). The final SEM of the factors influenced gasohol 91 consumption was presented in Figure 3. The findings showed that the final SEM was fit with the empirical data with CMIN/DF = 2.204, IFI = 0.972, TLI =

0.970, CFI = 0.972, RMSEA = 0.049, and HOELTER = 246 as shown in Table 1.

From reliability testing of the final SEM, it was found that Cronbach's alpha coefficients ranged from 0.941 to 0.983 and CR ranged from 0.947 to 0.984 were greater than 0.70. For convergent validity assessment, it was found that standardized loadings of the measurement models were ranged from 0.817 to 0.982 shown in the final SEM in Figure 3 and AVE was ranged from 0.781 to 0.890 that was above 0.50. Besides discriminant validity assessment by checking the cross-loadings, it was found that the values of factor loadings were high with their respective constructions. Overall, the final SEM in this study was reliable and valid.

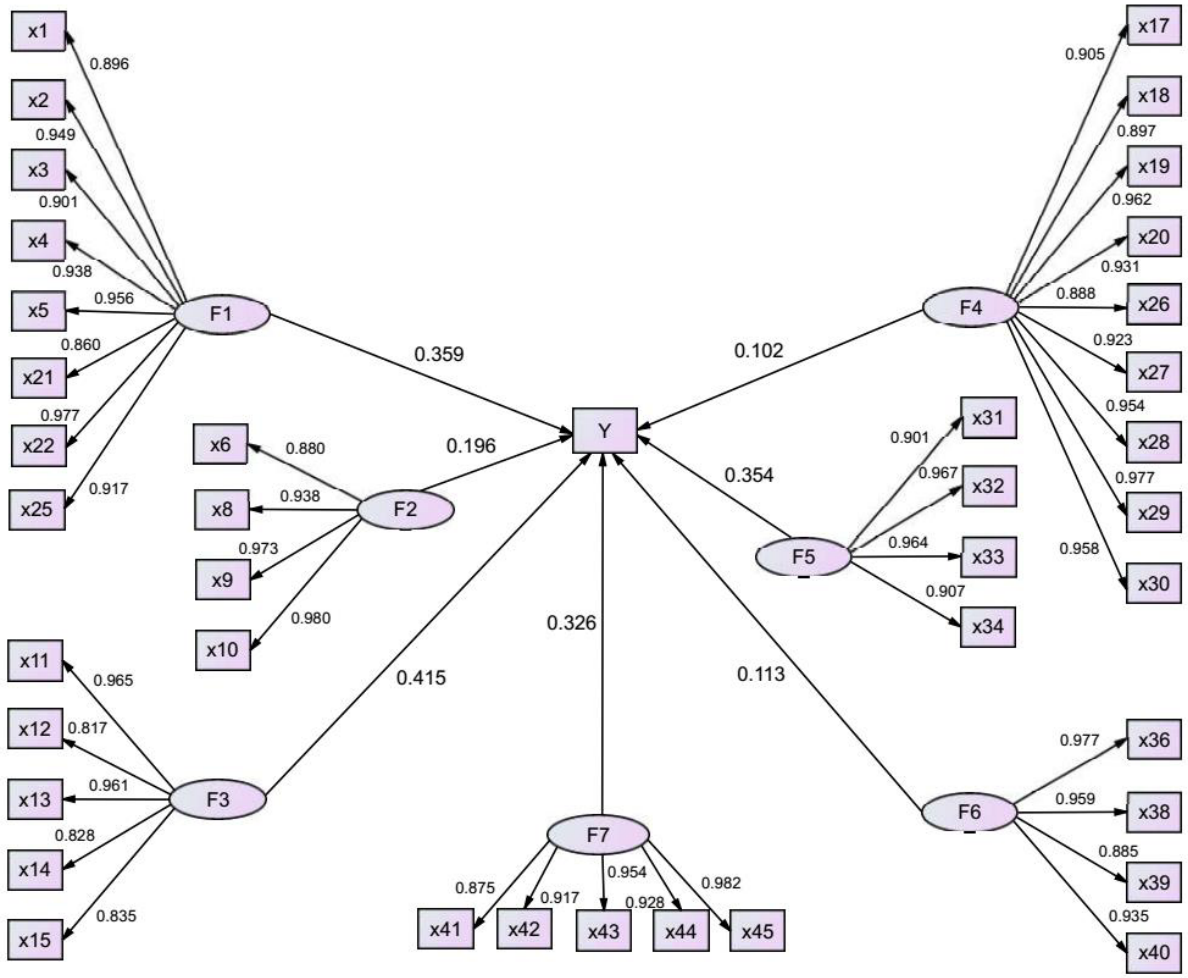

Figure 3 Final SEM of the factors influencing gasohol 91 consumption

Table 1 Advantages of fit indices

Advantages of fit indices	Recommended level	Final SEM on gasohol 91	Final SEM on gasohol E20
CMIN/DF	≤ 3.00	2.204	2.201
IFI	≥ 0.90	0.972	0.970
TLI	≥ 0.90	0.970	0.968
CFI	≥ 0.90	0.972	0.970
RMSEA	≤ 0.05	0.049	0.049
HOELTER .05	> 200	246	244

The standardized path coefficients of the relationship among the constructions were completely significant shown in Table 2. This indicated that all of the hypotheses (H1-H7) were supported at the acceptable significance level of p-value being less than 0.05 and Critical Ratio being greater than 1.96. Therefore, the factors significantly affected gasohol 91 consumption as follows: information, price, gas station, public relations, alternative assessment, purchase decision, and satisfaction. In Table 2, gas station (path coefficient 0.415) is a factor that has the greatest influence on gasohol 91 consumption, information (path coefficient 0.359), alternative assessment (path coefficient 0.354), satisfaction (path coefficient 0.326), price (path coefficient 0.196), purchase decision (path coefficient 0.113), and public relations (path coefficient 0.102) at a significance of 0.05. Also, those factors were able to predict gasohol 91 consumption at 83.40 percent (R^2 = 0.834). The relationship was as follows:

Gasohol 91 consumption (Y) = 0.415F3 + 0.359F1 + 0.354F5 + 0.326F7 + 0.196F2 + 0.113F6 + 0.102F4

Table 2 The standardized path coefficients of the final SEM on gasohol 91

Hypothesis	Relationship between Constructs	Standardized Path Coefficient	Critical Ratio	p-value
H1	Y <--- F1	0.359	16.088	***
H2	Y <--- F2	0.196	8.767	***
H3	Y <--- F3	0.415	18.877	***
H4	Y <--- F4	0.102	4.991	***
H5	Y <--- F5	0.354	16.151	***
H6	Y <--- F6	0.113	5.467	***
H7	Y <--- F7	0.326	15.105	***

Note: *** indicates p-value less than 0.001

2. Gasohol E20

Referring to data collecting from the sample who used gasohol E20, it was showed that the mean of each item related to the factors of using biofuels of a motorcycle ranged from 3.06 to 4.50, and the standard deviation ranged from 0.485 to 1.274. The mean and the standard deviation of gasohol E20 consumption were 28.446 litres and 10.087 litres respectively. For the normality test showed that the absolute values of SI were less than 2 and the absolute values of KI were less than 7. From the results of the initial SEM analysis and model refinements, it was found that a total of two observed variables as X23 and X37 was eliminated due to their low correlations (standardized loadings < 0.50). The final SEM was presented in Figure 4. The findings showed that the final SEM was fit with the empirical data with CMIN/DF = 2.201, IFI = 0.970, TLI = 0.968, CFI = 0.970, RMSEA = 0.049, and HOELTER = 244 shown in Table 1.

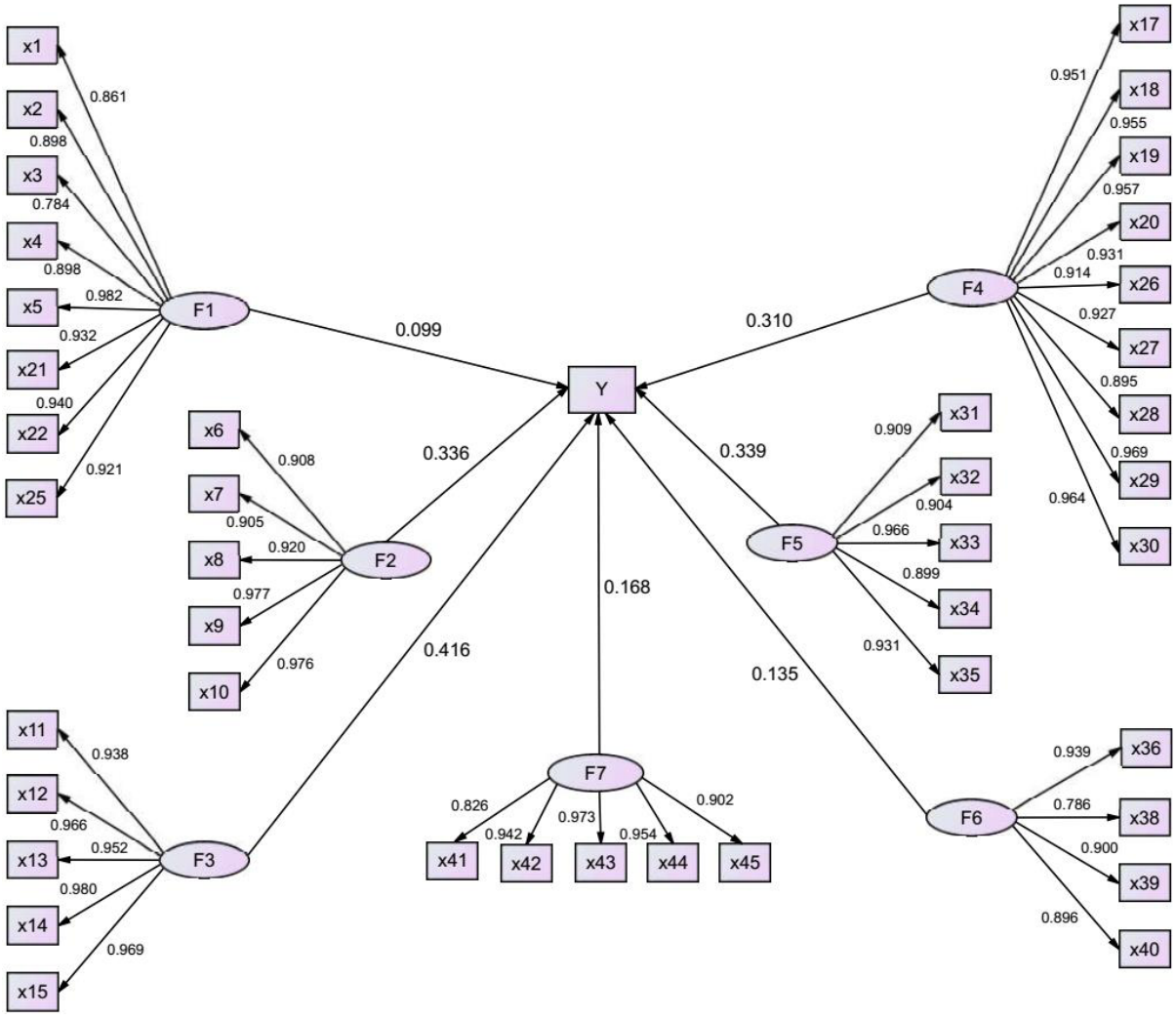

Figure 4 Final SEM of the factors influencing gasohol E20 consumption

From reliability testing of the final SEM on gasohol E20, it was found that Cronbach's alpha coefficients was ranged from 0.925 to 0.983 and CR was ranged from 0.933 to 0.986. For convergent validity assessment, it was found that standardized loadings of the measurement models were ranged from 0.784 to 0.982 in the final SEM as well as in Figure 4. Also, AVE was ranged from 0.778 to 0.924. In addition to discriminant validity assessment by checking the cross-loadings, it was found that the values of factor loadings were high in accordance with their respective constructions. Overall, the final SEM in this study was reliable and valid.

The standardized path coefficients of the relationship among the constructions were completed significant in Table 3. This indicated that all of the hypotheses (H-H7) were supported at the acceptable significance

level of p-value being less than 0.05. Also, Critical Ratio was greater than 1.96. As a result of the study, the factors that significantly influenced gasohol E20 consumption were from the same factors as gasohol 91. Besides, gas station respectively was the most influence on gasohol E20 consumption (path coefficient 0.416), alternative assessment (path coefficient 0.339), price (path coefficient 0.336), public relations (path coefficient 0.310), satisfaction (path coefficient 0.168), purchase decision (path coefficient 0.135), and information (path coefficient 0.099) at a significance of 0.05. Also, those factors were able to predict gasohol E20 consumption at 86.30 percent (R2 = 0.863). The relationship was as follows:

Gasohol E20 consumption (Y) = 0.416F3 + 0.339F5 + 0.336F2 + 0.310F4 + 0.168F7 + 0.135F6 + 0.099F1

According to gasohol E20 results, information was the factor that was related to a few effects on gasohol E20 consumption. Therefore, the emphasis on information has influenced consumers to turn their little consumption of gasohol E20.

Table 3 The standardized path coefficients of the final SEM on gasohol E20

Hypothesis	Relationship between Constructs	Standardized Path Coefficient	Critical Ratio	p-value
H1	Y <--- F1	0.099	5.127	***
H2	Y <--- F2	0.336	15.479	***
H3	Y <--- F3	0.416	19.658	***
H4	Y <--- F4	0.310	16.100	***
H5	Y <--- F5	0.339	17.009	***
H6	Y <--- F6	0.135	6.991	***
H7	Y <--- F7	0.168	8.825	***

Note: *** indicates p-value less than 0.001

Based on the analysis of factors affecting the consumption of gasohol 91 and gasohol E20 of motorcycles, gas station is the most important factor. For Gasohol 91, Variable X11: The number of gas stations are numerous and sufficient to demand. This has the highest standardized loading. These indicate that the number of gas stations affect the consumption of gasohol 91. For gasohol E20, variable X14: Gas stations have beautifully landscaped, seats for rest, clean bathroom, and convenience store with the

highest standardized loading. These show that the environment of the gas station affects the consumption of gasohol E20. The results were similar to the studies of Lertharn (2009); Lilarungrot (2016); Putsom (2011); Wachirakomen and Ativetin (2015). It was found that gas station as a factor influenced on the purchase decision of consumer. This is because the consumers focus on the convenience of service provided, meanwhile nowadays gasohol 91 and gasohol E20 are being distributed to almost every gas station. For this reason, consumers can fill their motorcycles with gasohol 91 and gasohol E20 easily. Therefore, to increase the amount of biofuels consumption, the gas station should be expanded to fulfill the consumers' need in each area as well as should have the well-organized environment.

Recommendation

The research result indicates that the gas station factor is the most crucial factor. It affected the consumption of gasohol 91 and gasohol E20. The consumers choose to use biofuels due to the basic consideration of the gas station environment such as its convenience. In order to achieve the target rate of the biofuels consumption in 2036, the government as well as the Ministry of Energy, or the other stakeholders should consider the factor on the gas station environment as their first priority. The suggestions are as follows: That is an increased numbers of the gas stations. The gas stations should offer all types of biofuels. Also, the service should be immediate and the consumers should not wait in a long queue.

The future studies should analyze the Structural Equation Modeling of gasohol 95 and gasohol E85 consumption of motorcycles as well as the risk management of factors affecting biofuels consumption of motorcycles.

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Appendix A: Explanation of observed variables

Observed variable	Explanation
F1: Information	
X1	Biofuels are safe to use.
X2	Biofuels result in efficient engine being comparable to gasoline.
X3	Biofuels can be mixed with gasoline left in the tank. No need to wait for gasoline to be empty.
X4	Biofuels make the combustion complete, so the engine is clean.
X5	Biofuels do not negatively affect the engine.
X21	Biofuels help to save the budget of Methyl Tertiary Butyl Ether (MTBE) import.
X22	Biofuels help raise the prices of agricultural crops as well as increase income for farmers.
X23	Biofuels help achieve the target for the oil management plan in 2015-2036.
X25	Biofuels help reduce air pollution.
F2: Price	
X6	The biofuels price is lower than gasoline.
X7	Each of biofuels price is not flexible. So, you are able to choose the cheapest biofuels.
X8	The volatility of gasoline prices make you turn to biofuels.
X9	Biofuels are worthiness for short-term use.
X10	Biofuels are worthiness for long-term use.
F3: Gas station	
X11	The number of gas stations are numerous and sufficient to demand.
X12	Gas stations sell several types of biofuels.
X13	Gas stations have enough biofuel feeders to provide fast service.
X14	Gas stations have beautifully landscaped, seats for rest, clean bathrooms, and convenience store.
X15	Gas stations are close to home, workplace or even on regular traveling routes.
F4: Public relations	
X17	The biofuels producers advertise the demonstration of engine performance when using biofuels.
X18	Motorcycle manufacturers have the quality assurance to ensure biofuels use.

Appendix A: Explanation of observed variables (Continued)

Observed variable	Explanation
X19	The government has partnered with motorcycle manufacturers and gas stations to increase confidence among consumers by promoting and advertising the use of biofuels.
X20	Government agencies promote and campaign to motivate and increase confidence when using biofuels.
X26	Information of biofuels comes from the people whom the consumers are close to.
X27	Information of biofuels comes from public relations through media such as television, posters, newspapers or social media (Line or Facebook).
X28	Information of biofuels comes from government agencies or private organizations that are responsible for this matter.
X29	Information of biofuels use has been obtained from reliable institutions such as educational institutions.
X30	Information of biofuels gets from their own experience.
F5: Alternative assessment	
X31	There is an evaluation of lower price than gasoline.
X32	There is an evaluation of efficiency that is equivalent to the use of gasoline.
X33	There is an evaluation of after-sales service or motorcycle garage with adequate quality and standard.
X34	There is an evaluation of the participation from the decision of family or people whom the consumers are close to.
X35	There is an evaluation of worthiness to adjust the engine for older model motorcycles such as FFV conversion kit retrofitting.
F6: Purchase decision	
X36	There is a decision to use biofuels because it reduces air pollution.
X37	There is a decision to use biofuels because it supports the policy of the government.
X38	There is a decision to use biofuels because it makes the consumers feel comfortable to help farmers.

Appendix A: Explanation of observed ariables (Continued)

Observed variable	Explanation
X39	There is a decision to use biofuels because it reduces travel costs.
X40	There is a decision to use biofuels because it is safe.
F7: Satisfaction	
X41	There is a recommendation of the acquaintance or people whom the consumers are close to when using the same type of biofuels.
X42	There is a repeat use of biofuels on another occasion.
X43	There is overall satisfaction with the use of biofuels compared to expectations.
X44	There is a switch to other types of biofuels that are expected to be better.
X45	There is a recommendation of the acquaintance or people whom the consumers are close to when using better biofuels.