Examination of Variables Impacting the Choice to Adopt Biofuel Among Consumers in Can Tho City

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Abstract

This research conducted in Can Tho City aims to discern the factors influencing consumers' decisions to use biofuel, with the ultimate goal of proposing impactful policies to encourage biofuel consumption. Employing quantitative methods, including descriptive statistics, Cronbach's Alpha test, exploratory factor analysis, and binary logistic regression, the study delves into consumers' environmental concerns and preferences. Findings highlight air pollution as the foremost environmental issue, with water and soil pollution following. The regression model identifies significant positive correlations between variables such as Environmental concern, Usefulness, Product knowledge, Seller, and educational level with consumers' biofuel usage decisions. Among these, Seller exerts the most substantial influence. The study suggests key solutions, including robust information dissemination policies, comprehensive training for gas station staff, encouragement of biofuel use among producers, government interventions in the automotive industry, quality management policies, capacity building through international collaboration, and an emphasis on ensuring both quantity and quality at fuel retailers. These proposals aim to address consumer concerns, enhance awareness, and establish trust in biofuel, laying the groundwork for its widespread adoption in Can Tho City.

Keywords: Consumer Behavior, Green Consumption, Biofuel, Can Tho City.

Introduction

In the present era, petroleum and natural gas contribute to approximately 60-80% of the world's energy sources. With the current growth rate and existing reserves of crude oil, this energy source is rapidly depleting. Moreover, the complexities in the current oil prices are influenced by the increasing demand for crude oil and instabilities in oil-producing countries. Furthermore, the raw materials for these products have been causing environmental pollution worldwide, leading to phenomena such as the greenhouse effect, ozone layer depletion resulting in global warming, and emissions like sulfuric acid and nitric acid causing acid rain. Climate change is becoming increasingly apparent, with its negative scenarios potentially unfolding faster than predicted, and Vietnam stands as one of the most heavily affected nations. At the 21st Conference of the United Nations Framework Convention on Climate Change (COP-21) in Paris, the Vietnamese Prime Minister made a significant speech committing to continue implementing the UN Framework Convention on Climate Change and outlining Vietnam's CO2 reduction roadmap by 2030.

The use of biofuels as a substitute for fossil fuels is crucial in reducing greenhouse gas emissions and protecting the environment. Biofuel was introduced in Vietnam in 2010, deemed as a cheap, clean, and abundant fuel alternative. However, according to 2021 statistics, in Can Tho City, there are

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approximately 85 retail outlets for petroleum products, and the demand predominantly consists of Ron 92-II and Ron 95-II, with only a minimal portion being biofuel. Therefore, understanding the factors influencing the decision to use biofuel becomes important and necessitates research. The outcomes of this study will help us uncover the determinants affecting customers' usage decisions, thereby facilitating the development of appropriate solutions that directly or indirectly impact customer decisions.

Literature Review and Research Model

Theoretical foundation

Biofuel

According to Fabien and colleagues (2010), synthesizing definitions from an industrial perspective, a green product is one that adheres to the "3R" characteristics: "reduce," "reuse," and "recycle"; certified by an official entity; and not tested on animals. Biodegradability is also a crucial component of a green product. From a consumer standpoint, based on a survey regarding green household cleaning products, customers perceive a green product as: (1) non-toxic to nature; (2) beneficial for health; (3) socially responsible; and (4) good for the planet. Environmental protection and health considerations are deemed essential factors, while certification is not considered part of the green product definition.

Benefits of Using Biofuel

The utilization of biofuel brings about five advantages:

High Octane Rating: Bioethanol possesses a high-octane number (RON 109), enhancing the octane rating when blended with conventional gasoline. This elevates combustion efficiency, reduces the risk of knocking, and contributes to smoother engine operation.

Reduced Dependency on Fossil Fuels: Biofuel usage diminishes reliance on fossil energy sources, supplements deficient fuel supplies, decreases imported petroleum, and ensures national energy security.

Lower Environmental Emissions: Bioethanol emits fewer environmentally harmful pollutants (such as CO_2 and hydrocarbons) compared to traditional gasoline, thereby contributing to greenhouse gas reduction.

Environmentally Friendly: Biofuels exhibit environmental friendliness due to their renewable and biodegradable characteristics.

Economic and Social Contributions: The use of biofuel contributes to the economic and social development of local communities and growing economic sectors. The demand for raw materials in biofuel production creates new employment opportunities and income for farmers.

Limitations of Biofuel

While biofuels, including bioethanol, offer environmental benefits, they also have three main drawbacks:

Emissions Reduction: While biofuels reduce emissions of harmful gases into the environment, the combustion process still results in the release of toxic gases. However, considering the closed carbon cycle involving CO_2 absorption by feedstock crops for ethanol production, the overall greenhouse gas effect is reduced compared to traditional gasoline.

Production Costs: In Vietnam, the production and trade of biofuels are in their infancy, leading to higher production costs that heavily depend on input prices. Additionally, the complexity of technology investment in production, blending, quality monitoring throughout the production and transportation phases complicates the biofuel supply chain, resulting in higher production and business costs compared to traditional gasoline.

Compatibility with Engine Components: While ethanol blends below 5% do not necessitate modifications to engine materials, higher ethanol content in fuel may impact various engine components, including metals, rubber, plastics, and polymers. It's important to note that bioethanol has hygroscopic properties, potentially causing phase separation if the biofuel-containing vehicle is inactive for more than three months, affecting the engine.

Consumer Behavior Models

Consumer behavior models encompass various perspectives to understand the purchasing decision process. Here is a description of some important models:

Classic Model: Central to this model is the customer's buying decision, revolving around factors such as attitude, behavior patterns, needs, personal opinions, and learning. The model extends to factors like family, economy, business, culture, and society.

EKB Model (Engel-Kollatt-Blackwell): Focuses on the purchasing decision process, including inputs, information processing, specific variables of the decision-making process, and external influences.

Howard-Sheth Model: Concerns the consumer, user, and payer. It has four general factors: input, perceptual constructs, learning constructs, and output (internal or external).

Bettman Model: Focuses on the information processing process with scanning/interrupt structures to describe customer behavior.

HCB Model (Hawkins-Coney-Best): Emphasizes the purchasing decision process, self-image, and lifestyle, with two impact structures being external and internal influences.

Solomon Model: Focuses on consumer behavior, considering customers as independent individuals and exploring the culture they belong to.

Peter-Olson Model: Researches consumer behavior in the form of the "Customer Analysis Wheel" with three basic components: Behavior Component, Perception and Emotion Component, and Environmental Component.

Each model provides an in-depth view of how consumers make purchasing decisions from various perspectives.

Hypothesis and Research Model

Johan Janson and Agneta Marell (2010) conducted a study on green consumer behavior: Determinants of curtailment and eco-innovation adoption. The aim was to analyze factors influencing green consumer behavior and the acceptance of consumer eco-innovations. The authors interviewed 1832 consumers, utilizing principal component analysis, descriptive statistical methods, and linear regression to achieve their research objectives. Results indicated that factors such as values, beliefs, standards, the strength of habits, and readiness to embrace innovation influenced consumers' green behavior.

S. Sarumathi (2014) explored green purchase behavior – A Conceptual Framework of Socially Conscious Consumer Behavior. The research aimed to build a model of factors influencing consumer green behavior. Independent variables considered included environmental knowledge, perception of environmental issues, environmental awareness, environmental beliefs, and concerns about environmental issues. These factors were examined in relation to consumer attitudes, subsequently influencing purchasing intentions and, ultimately, green consumer behavior.

In Lin and Huang's study (2012) on determining factors affecting the choice of green products, significant differences were found between high-priced and low-priced green products in consumer decision-making. Additionally, the knowledge value of green products positively impacted consumer choices, fostering curiosity and a desire for knowledge, increasing the likelihood of selecting green

products. Perceived value also played a role, with significant connections to product attributes positively influencing consumer choices. Two aspects related to this value were global environmental threats and warnings, and emotional value positively affected consumers' choices of green products. Consumers viewed the act of choosing green products as contributing to environmental protection, generating positive emotions about doing something good for themselves and society as a whole.

According to Beyzavi and Lotfizadeh (2014), social factors play a crucial role in determining appropriate behavior, shaping what individuals must do and what they intend to do. Finally, social values and behaviors shaped by rules from a social class and profession influence the actions that members within that social stratum are expected to follow.

Thus, the studies mentioned above indicate that consumer perception, environmental concern, supplier influence, and demographic factors all demonstrate an impact on the consumer's choice of green products. Therefore, the hypotheses are formulated as follows:

H1*: Product knowledge positively influences the decision to use biofuel by consumers in Can Tho City.*
H2*: Environmental concern has a positive impact on the decision to use biofuel by consumers in Can Tho City.*
H3*: Usefulness positively affects the decision to use biofuel by consumers in Can Tho City.*
H4*: Seller has a positive influence on the decision to use biofuel by consumers in Can Tho City.*
H5*: Income has a positive impact on the decision to use biofuel by consumers in Can Tho City.*
H6*: Educational level positively influences the decision to use biofuel by consumers in Can Tho City.*

Figure 1: Research Model.
Figure 1: Conceptual Framework.
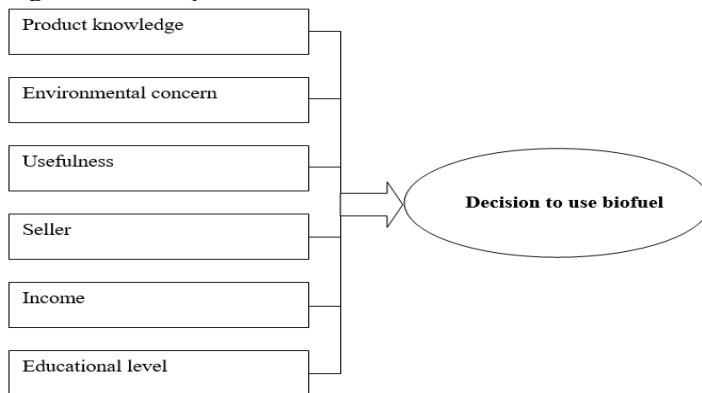
Research Methods

To gather information for this research, the author conducted primary data collection using a convenient sampling method. Consumer interviews were conducted using a pre-prepared questionnaire at major gas stations in the city of Can Tho. The target population for data collection included consumers aged 20 to 55, as this age group actively participates in traffic and, for the most part, has stable income, financial independence, and limited influence from others, based on the pre-prepared interview questionnaire.

In the research model on the factors influencing the decision to use biofuel by consumers in Can Tho City, a total of 25 observed variables were considered. Considering factors such as time, cost, convenience in sampling, and sample usage, the author chose a sample size of 270 for the study. The research team employed tests such as the reliability test with the Cronbach's Alpha coefficient, exploratory factor analysis (EFA), and Binary Logistic regression model to analyze the factors influencing the decision to use biofuel by consumers in Can Tho City.

Research Results

Assess the Reliability of the Scale Using Cronbach's Alpha Coefficient

The reliability of the scales was examined using Cronbach's Alpha coefficient. This coefficient helps eliminate variables and scales that do not meet the criteria. Variables with corrected item-total correlation below 0.3 were excluded, and the criterion for selecting scales was a Cronbach's Alpha above 0.6 (Nunnally and Burnstein, 1994). Additionally, if the Cronbach's Alpha coefficient is too high (above 0.95), it indicates that many variables in the scale do not differ from each other (meaning they measure the same aspect of the research concept). The results of the Cronbach's Alpha test for the independent variables in the first round showed that the variables related to the statement 'When it comes to fuel, I immediately know it is a product made from plants and animal fats, thus environmentally safe' had total correlation coefficients below 0.3, so these variables were excluded from the research model. The results of the Cronbach's Alpha test for the independent variables in the second round with 24 variables showed that the overall Cronbach's Alpha coefficients for the factor groups ranged from 0.662 to 0.849 (falling within the range from 0.6 to 1.0), indicating that the scale is reliable (Peterson, 1994). Examining the total correlation coefficients of the variables, none of the 24 observed variables had a correlation coefficient below 0.3, demonstrating that all these variables are reliable (Nunnally & Burnstein 1994). Therefore, all 24 observed variables met the conditions for further factor analysis.

The Exploratory Factor Analysis

The exploratory factor analysis was conducted using the Principal Component method and the Varimax factor rotation method. The results of the factor analysis with 24 observed variables formed 4 factor groups, and the criteria for verification were ensured: (1) Reliability of the observed variables (Factor loading > 0.5); (2) Suitability test of the model with $0.5 < KMO = 0.843 < 1.0$, indicating that the factor analysis is appropriate for the data in the model; (3) Bartlett's test of correlation between observed variables, $Sig = 0.000 < 0.05$, indicating a strong correlation between variables; (4) Cumulative variance test = 67.920% > 50%. The results of the factor analysis are presented through the rotated factor matrix in Table 1 as follows:

Table 1: Rotated Factor Matrix.

Variable	Factor			
	1	2	3	4
PK1			0.820	
PK2			0.769	
PK3			0.804	
PK4			0.648	
PK5			0.729	
PK6			0.661	
EC1	0.799			
EC2	0.759			
EC3	0.824			
EC5	0.696			
EC6	0.638			
EC7	0.693			
EC8	0.782			
US1		0.638		
US2		0.873		
US3		0.700		
US4		0.523		
US5		0.649		
US6		0.612		
SE1				0.747
SE2				0.833
SE3				0.753
SE4				0.796
SE5				0.852

Binary Logistic Regression

Analysis Binary logistic regression analysis was conducted with 6 independent variables. Among them, 4 independent variables were derived from the results of the factor analysis method, and 2 demographic variables of consumers, namely age and educational level. The dependent variable was the decision to use biofuel by consumers. After performing the logistic regression, the results showed: (1) The hypothesis test regarding the overall appropriateness had a significant P-value of 0.000, leading to the rejection of the null hypothesis (H0) that the regression coefficients of all independent variables are zero. (2) The value of -2 Log likelihood = 13.046 indicates the overall fit of the model. With these results, it can be observed that the logistic regression model is well-fitted.

Table 2: Results of Binary Logistic Regression Analysis Model.

Factor	B Coefficient	P value	Marginal Effects
Environmental concern	3,537	0,054	0,801
Usefulness	3,070	0,018	0,684
Product knowledge	4,066	0,001	1,034
Seller	6,701	0,024	1,600
Income	-0,314	0,185	-0,003
Educational level	2,006	0,021	0,416
Constant	-6.927	0,001	-
Predicted Probability			61.384
-2 Log likelihood			13.046
Number of observations			270

The results in Table 2 indicate that, among the variables included in the model, there are 5 statistically significant variables: Environmental concern, Usefulness, Product knowledge, Seller, and Educational level. All these variables show a positive correlation with the decision to use biofuel by consumers. Among the significant variables, Seller has the highest impact on the decision to use biofuel among consumers. Following this, in descending order of influence, are Product knowledge, Environmental concern, Usefulness, and Educational level of consumers.

Environmental concern has a positive correlation with the decision to use biofuel by consumers. When consumers prefer to use a product that does not cause pollution to the environment and are aware that using biofuel does not require changing the engine structure or worrying about the stability and quality of the fuel affecting the engine, the probability of consumers deciding to use biofuel increases.

Product knowledge has a positive correlation with the decision to use biofuel by consumers. When consumers are aware that biofuel is good for the vehicle's engine and the government encourages biofuel usage, the probability of consumers deciding to use biofuel increases.

Usefulness has a positive correlation with the decision to use biofuel by consumers. When consumers are concerned about the usefulness of biofuel, such as its environmental friendliness, its contribution to reducing dependence on fossil fuels, cost savings compared to conventional fuel, and its role in diversifying the national energy sources, the probability of consumers deciding to use biofuel increases.

Seller has a positive correlation with the decision to use biofuel by consumers. When biofuel is easily accessible, available at places with clear signage indicating the availability of biofuel, and the seller has knowledge about biofuel to provide information to customers, the probability of consumers deciding to use biofuel increases.

Educational level of consumers has a positive correlation with the decision to use biofuel. When the educational level of consumers increases, their awareness of environmental issues also increases.

Additionally, with higher educational levels, consumers are more likely to access and understand information about environmental issues, scientific and technological advancements in the field of biofuels through various sources of information, leading to an increased probability of them deciding to use biofuel.

Conclusion

The research aims to identify the factors influencing the decision to use biofuel by consumers in the city of Can Tho. The goal is to propose key policy implications to attract customers and promote the consumption of biofuel in Can Tho. To achieve the research objectives, quantitative research methods were employed, including descriptive statistics, Cronbach's Alpha test, exploratory factor analysis, and binary logistic regression.

The study results reveal the level of consumer interest in environmental pollution issues through surveying their opinions and evaluations of statements. The agreement level of consumers with these statements reflects their concern about environmental pollution. Air pollution is the most significant environmental issue for consumers, followed by water pollution, and finally, soil pollution.

The regression model results show that the variables Environmental concern, Usefulness, Product knowledge, Seller, and Educational level all have a positive correlation with the decision to use biofuel by consumers. Among the significant variables, Seller has the highest impact on consumers' decision to use biofuel. Following this, in descending order of influence, are Product knowledge, Environmental concern, Usefulness, and Educational level of consumers.

From the research findings, some proposed solutions are as follows:

Policy on Information Dissemination: Government agencies should provide and disseminate information about biofuel across various media channels such as television, newspapers, magazines, and reputable online platforms like vnexpress, thanh niên, tuổi trẻ. Additionally, information about biofuel should be regularly updated in community bulletins to ensure widespread access and accurate understanding of its advantages.

Training for Gas Station Staff: Gas station employees should receive training on biofuel to effectively advise and address consumer queries. Given that station staff are direct points of contact with consumers, their understanding of biofuel benefits can significantly influence and persuade consumers to use it. Visible signage and banners at stations selling biofuel should also be implemented.

Encouraging Usage among Biofuel Producers: Biofuel-producing companies should encourage their staff to use biofuel. Through personal relationships, employees can effectively communicate information to a broader audience, increasing awareness and adoption. From a technical perspective, biofuel is derived from the RON 92 gasoline platform, blended with bioethanol, enhancing its properties. Moreover, the pricing of biofuel is competitive with RON 92 gasoline.

Government Intervention for Vehicle Manufacturers and Distributors: Government policies should influence vehicle manufacturers and distributors to provide advice, assuring consumers about the safe use of biofuel. Policies related to the distribution system of biofuel should involve investments in storage facilities and widespread distribution to tackle accessibility issues faced by consumers.

Quality Management Policy: Government standards should be established for the strict regulation of biofuel quality throughout the production, blending, transportation, storage, and market circulation phases. Biofuel-producing companies must adhere rigorously to these quality standards to ensure consumer trust in safety, environmental friendliness, and overall product quality.

Capacity Building and International Collaboration Policy: Biofuel-producing companies should send experts to learn from countries with extensive experience in biofuel adoption. Ongoing education and skill development programs for gas station staff and distributors will contribute to a knowledgeable and confident promotion of biofuel.

Ensuring Quantity and Quality at Fuel Retailers: Gas station retailers should maintain a sufficient quantity and quality of biofuel to meet consumer demand. For a new product like biofuel, building trust and credibility with consumers is crucial, and retailers should actively manage the quality of biofuel from the outset of its introduction to the market.

References

Ajzen, I. (2012). Martin Fishbein's legacy: The reasoned action approach. The ANNALS of the American Academy of Political and Social Science, 640(1), 11–27. doi: 10.1177/0002716211423363

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. Psychological Bulletin, 103(3), 411-423.

Chen, T. B., & Chai, L. T. (2010). Attitude towards the environment and green products: Consumers' perspective. Management Science and Engineering, 4(2), 27–39.

Janson, J., & Marell, A. (2010). Green consumer behavior: Determinants of curtailment and eco-innovation adoption. Journal of Consumer Marketing, 04/2010, 358–370.

Kwong, G. S., & Balaji, M. S. (2016). Linking green skepticism to green purchase behavior. Journal of Cleaner Production, 131, 629–638. doi: 10.1016/j.jclepro.2016.04.122

Leonidou, C. N., & Skarmeas, D. (2015). Gray shades of green: Causes and consequences of green skepticism. Journal of Business Ethics, 144(2), 401–415. doi: 10.1007/s10551-015-2829-4

Majumdar, S., & Swain, S. C. (2015). Identification of factors influencing preferences for green products: A study in and around Kolkata (India). Academicia: An International Multidisciplinary Research Journal, 5(4), 354–370.

Mainieri, T., Barnett, E. G., Valdero, T. R., Unipan, J. B., Mainieri, T., Barnett, E. G., … Valdero, T. R. (2017). Green buying: The influence of environmental concern on consumer behavior. The Journal of Social Psychology, 137(2), 37–41. doi: 10.1080/00224549709595430

Matthes, J., & Wonneberger, A. (2014). The skeptical green consumer revisited: Testing the relationship between green consumerism and skepticism toward advertising. Journal of Advertising, 43(2), 115–127. doi: 10.1080/00913367.2013.834804

Peterson, R. (1994). A Meta-Analysis of Cronbach's Coefficient Alpha. Journal of Consumer Research, 21(2), 38-91.

Sarumathi, S. (2014). Green purchase behavior – A Conceptual Framework of Socially Conscious Consumer Behavior. Global Journal of Finance and Management, 6(8), 777–782.

Thompson, S. C. G., & Barton, M. A. (1994). Ecocentric and anthropocentric attitudes toward the environment. Journal of Environmental Psychology, 14(2), 149–157. doi: 10.1016/S0272-4944(05)80168-9