CUSTOMER SATISFACTION OF INNOVATIVE INSTANT RICE MILL MACHINE FOR HOUSEHOLD USE IN THAILAND

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ABSTRACT

Purpose

Based on the importance of rice farming to household income and economy of Thailand, the purpose of this research is to evaluate the satisfaction levels of the innovative rice mill machine for household use in Thailand, and hence develop the recommendations towards its development.

Design/Methodology/approach

The data was collected from 302 household users fond of active, healthy, social lifestyle, etc. using random sampling method in Thailand who had tested the machine. The independent variable was innovative rice mill with four constructs (structure, quality, usability, and value) while the dependent variable had been customer satisfaction as evaluate by 8P's marketing mix. The analysis was carried out using SPSS and SmartPLS 3.2.7. The technique applied included structural equation modelling (SEM) to examine the relationship between the dependent and independent variables.

Findings

The findings of the research indicated that the four constructs of the innovative rice meal – its quality, its structure, its value, and its application contributes to 71.4% of the satisfaction levels

of rice for household users, as explained by the marketing mix factors (Price, Product, Place & Time, Process, Productivity & Quality, People, Promotional & Time, and Physical evidence).

Recommendations

To innovate and produce innovative portable rice mill machine for, considering its high level of customer satisfaction, productivity, and efficiency. It is suitable for people who are passionate and love to have an active, healthy and social lifestyle.

INTRODUCTION
Globally, rice is strategically an important cereal crop, and more important in the developing countries. It is a staple food for more than half of the world's population. In Thailand, Rice production has played a critical role in Thailand socio-economic development, and the country has remained the world's largest rice exporter for the last three decades. Making a significant proportion of the country's foreign exchange earner through exports, it is a critical sectors for the economic development of the country due to its contribution both household as well as national income (Yanakittkul & Aungvaravong, 2020). The small scale and large-scale production of rice for export is usually, the milled rice.

Rice milling is an intermediate process in the overall process of rice production, which plays two critical roles. As a production unit, rice milling involves the conversion of rice paddy into milled rice. The unit also plays a critical role of purchasing the paddy rice from the farmers and plays the role of a distributive chain of the milled rice, to the consumers, government agencies and commercial merchants. The rice milling technology has evolved significantly through the development of rice milling machines, both for commercial and domestic use (Karichappan, Venkatachalam, Jeganathan & Sengodan, 2013). Considering that rice is the oldest known food, rice milling is built on a solid foundation. However, there is need to improve the milling technologies, innovations and capacities, to meet the market demands as well as quick and effective processing (Chung & Lee, 2003). Investment in better milling machines and equipment for husk removal is critical. This would add revenues through the innovative use of the leftovers.

Rice milling is an integral part of the processing steps, which are required to make rice an edible food product. The activity involves the removal of the husk from the grain and then removes the grain layers to reach to the white grain that lies underneath. If the milling process is conducted correctly, then the grain will be free from impurities (Farooque, Zaman, Halim, Islam, Hossain, Mollah & Mahmood, 2009).

Considering the modern rice milling machines, there are various operation, which are combined to produce a product that have a better quality, and higher yields, as

compared to the traditional milling technologies. The customer target market of this Rice Mill Machine includes people who love to live an active, healthy and social lifestyle and passionate about organic foods and organic rice grains. This machine can help answer their needs to satisfy their needs enabling them to mill rice conveniently at home since the machine is portable and occupies less space. The new technology is focusing on activities such as pre-cleaning the grains, removing husks through running the grains through two abrasive surfaces, and then the disposing the husks to prevent the final product contamination. Through there are several milling machines with varying milling capacities, there are varying conditions which are considered suitable for a quality rice product. The professional rice mills should produce approximately 60% whole kernels, while 10% should be composed of large broken kernels while the remainder should be small or broken kernels (Paranthaman, Alagusundaram & Indhumathi, 2009). An efficient rice mill husker should remove approximately 90% of the husks from the grains on a single pass since it is composed of 20% of total weight. Additionally, the mill should remove approximately 10% of the bran from the total paddy weight. Further, the mill should have the capacity to reduce the risk of breakage in rice processing, by passing it through the whitening machines before a finished product is created (Setboonsarng, Leung & Cai, 2006).

HOUSEHOLD INNOVATIVENESS OF MILLING MACHINE
For both household and commercial use, the quality of rice grain completely depends on the milling process and its associated technology. The extent of losses during milling depends on the various factors including rough rice condition and variety, milling degree required, type of mill used, and the level of technology applied (Setboonsarng, Leung & Cai, 2006). The milling of paddy is usually done to approximately 145 dry basis moisture content to produce a white polished editable grain based on the preferences of the consumer. The quality of the milled rice is critical since it influences the size, shape, whiteness, cleanliness's well as the price of the rice grains. This in-turn depends on the efficiency of the milling machine used and its technology levels. There are various milling machines designed for household use. According to researchers, these household innovations should possess various characteristics such as easy to operate, cheaper in cost, efficient and with detailed instructions. These machines should mill paddy directly to a polished rice, which is separated from the cracked rice, and fine bran at the same time. Based on this background, this research investigates the effects of a rice mill innovation to be used in households, and how it influences the marketing mix satisfaction of Thailand rice household users.

Purpose and Research Objectives

Based on the above background, the purpose of this research is to design and build a ready-to-use rice-milling machine, through the rice mill innovation for using in household and evaluate its effects on the marketing mix satisfaction of the household users. The following are the objectives of the research.

1. To evaluate the effects of the innovative instant rice mill machine on customers satisfaction
2. To determine the effect of customer satisfaction on marketing mix model
3. To develop a recommendation on the development and use of innovative instant rice mill machine

The scope of the study will revolve around three aspects. The first aspect is designing and building a household ready to use rice-milling machine. The second aspect is the testing the performance of the rice milling machine after its development. The third aspect involves the analysis of the possibility of actual implementation in terms of economic worthiness.

Purpose and research objectives

Innovation is a critical aspect of any development agenda, and it is more crucial if it involves supporting the domestic production and income. The proposed machine whose development and efficiency are evaluated in this research in terms of satisfying the Thailand rice household users marking mix has various proposed properties. These are highlighted below.

Ready to Use Milling Machine – Specifications of Instant Rice Mill Machine	
Milling type	White rice
Production capacity	About 26 kg/hr.
Capacity of paddy rice	500g
Power source	Electric motor 24 vdc 300W
Electrical requirements	Electric pot size 30 A 24 V
Body size	20 x 50 x 27 cm
Weight	12kg

The proposed ready-to-use rice mill has been developed and tested in presence of agricultural production experts to check its efficiency. It was found that the production capacity of the rice mill is approximately 26kg/hr. while the paddy rice capacity is 500g. The machine power source consumption would be electric motor 24vdc 300W while the electric requirements would include an electric pot size 30A 24V. The machine total weight is about 12kg, which is considered quite little making it portable and more suitable for household use, as compared to other

machines. Further, the innovated machine has a little body size as compared to previous developed domestic machines, as it total body size is 20 x 50 x 27 cm.
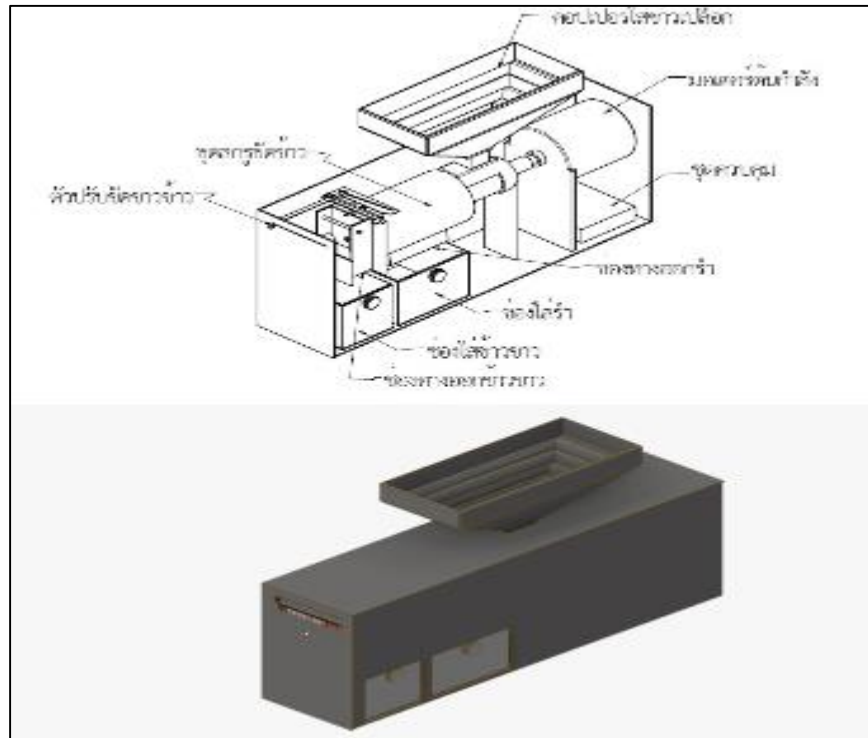
Figure 1: Prototype of the proposed milling machine

Evaluation of the Machine		
	Test Results	
Evaluation Indicators	**Khao Lueng Pathio**	**Typical Rice from Chumphon Province**
Speed of white rice polishing drum	3500 rpm	3000 rpm
Moisture of paddy	12.33%	14.56%
Rice full %	70%	70%
Broken rice %	30%	30%
Ability to work	26 kg/hr.	26 kg/hr.
Electricity charge	1.65 baht/hr.	1.19 baht/hr.
The cost of building a rice mill	15,000 baht	

Before release to the market, this machine underwent an extensive evaluation that demonstrated its effectiveness. It was tested on the Khao Lueng Pathio which is typically grown in the Chumphon province of Thailand. The tests results indicated that for the speed of white rice polishing grind the Khao Lueng Pathio would range between 300 and 3500 rpm. The moisture for the paddy was found to range

between 12.33% and 14.56%, which is quite satisfactory, as the recommended moisture should not be more than 15%. The results also indicated that the rice fill production capacity would be 70% while the remaining 30% would be the broken rice. The machine has a working capacity of 26kg/hr. and an electricity charge ranging from 1.19 baht to 1.65 baht/hr. the cost of building the machine was evaluated to be 15,000 baht, which is considered low, hence affordable for the household users in Thailand.



Figure 2: Photo of the proposed milling machine

8P's marketing mix and customer satisfaction
Every innovation is geared towards enhancing the levels of customer's satisfaction. The proposed ready-to-use rice milling has enhanced performance capabilities to increase its efficiencies with the enhanced specifications discussed in the previous section. Measuring customer satisfaction of the proposed milling machine is critical, as it dictates the ability of the machine to satisfy customers. Customer satisfaction is defined as the measurement of how a product or services supplied by a firm, company or business meet the expectations of the customers or end-users(Setboonsarng, Leung & Cai, 2006). The evaluation of the customers' satisfaction of the ready-to-use rice mill machine is critical in development of proposals to enhance the innovation and production of more efficient rice mills. The customers' satisfaction was assessed using the 8Ps Marketing Mix, as developed by Philip Kotler (Kotler, 2006). The BP's include Price, Product, Place & Time, Process, Productivity & Quality, People, Promotional & Time, and Physical evidence.

Conceptual Framework and Variables

The study is made up of two variables, the innovative ready-to-use rice mill and the customer satisfaction. The innovative ready-to-use is the independent variable composed of four observed variables (structure, application, quality and value), while the dependent variable is the customer satisfaction composed of the 8P's marketing mix (Price, Product, Place & Time, Process, Productivity & Quality,

People, Promotional & Time, and Physical evidence). The conceptual framework and the variables are shown in the following figure.
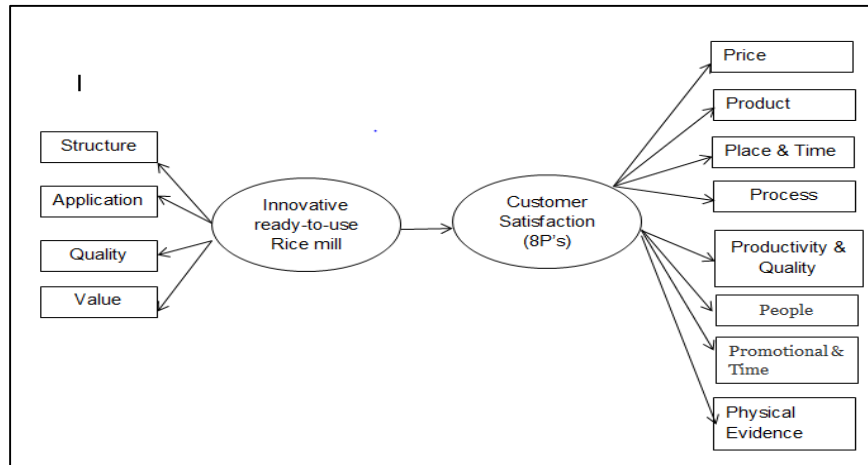
Figure 3: Conceptual Framework

RESEARCH METHODOLOGY
The study adopted a quantitative research design, with an objective of innovating, developing, producing, and supplying a ready-to-use rice mill machine for Thailand household use. The research assesses the customer satisfaction of the proposed rice mill using the 8P's Marketing Mix. The research population comprised of individuals with an intention to use the rice mill machine for domestic purposes. A representative sample of 320 respondents from the population which was selected using simple random sampling. A total of 240 responses was successfully received and used for analysis four areas of innovation will be the concern for the proposed ready-to-use rice mill machine, which includes 1) structure, 2) value, 3) quality and 4) application. The study assessed the ability of these areas of concern to influence the Thailand rice household users' satisfaction, as dictated by the 8P's of Marketing Mix. The data is collected from the selected sample, capturing various aspects of marketing mix, as well as the performance of the mill in terms of electricity usage, broken rice and speed. The data was analyzed using regression analysis and structural equation modeling (SEM) on SmartPLS and SPSS.

RESEARCH FINDINGS
Concerning the demographic characteristics of the respondents, the study found that men were the majority household users (50.8%) than women (49.2%). Most rice household users (47.9%had master's education levels, while 27.9% of the household users had bachelor's degree. The statistics also indicated that most household users 43.8% had6-10 Years of experience while 28.3% had an experience of 1-5 Years. Most household users 47.9% were indicated to be

earning an average of 10,001 – 40,000 Baht monthly income. These statistics are summarized in the table below.

	Gender			
	Frequency	Percent	Valid Percent	Cumulative Percent
Gender				
Male	122	50.8	50.8	50.8
Female	118	49.2	49.2	100.0
Age				
Less than 20 years	49	20.4	20.4	20.4
21-30 years	58	24.2	24.2	44.6
31-40 years	68	28.3	28.3	72.9
41-50 years	25	10.4	10.4	83.3
>50 years	40	16.7	16.7	100.0
Education				
Below undergraduate	37	15.4	15.4	15.4
Bachelor	67	27.9	27.9	43.3
Masters	115	47.9	47.9	91.3
PhD	21	8.8	8.8	100.0
Occupation				
Government Official/State Enterprise	61	25.4	25.4	25.4
Private employees/Companies/Stores	69	28.7	28.7	54.2
Business Owner	1	.4	.4	54.6
Personal Business/Trader	28	11.7	11.7	66.3
Students	81	33.8	33.8	100.0
Monthly Income				
Less than 10,000 Baht	37	15.4	15.4	15.4
10,001 – 40,000 Baht	115	47.9	47.9	63.3
40,001 – 70,000 Baht	67	27.9	27.9	91.3
More than 70,000 Baht	21	8.8	8.8	100.0
Work Experience				
Under 1 Year	23	9.6	9.6	9.6
1-5 Years	68	28.3	28.3	37.9
6-10 Years	105	43.8	43.8	81.7
More than 10 Years	44	18.3	18.3	100.0
Total	240	100.0	100.0	

Aspects of Innovative Instant Rice Mill Machine

This section evaluated the satisfaction and performance levels of the innovative ready-to-use rice mills based on the views of the rice household users. The aspects evaluated include structure, application, quality and value. The statistics showed that the aspect with the highest rank is the product quality (mean = 4.43; std. 0.54)

The second in rank was product usability (mean = 4.42; std. deviation = 0.54). The third is in line is the product structure (mean = 4.35; std. deviation = 0.57) which was ranked high degree of satisfaction but had the highest standard deviation. The fourth aspect, and the least was the product value (mean = 4.35; std. deviation = 0.6), which was ranked high satisfaction levels.

Descriptive Statistics			
	Mean	Std. Deviation	Level of Satisfaction
Product Structure	4.35	0.57	High Level
Product Usability	4.42	0.54	High Level
Product Quality	4.43	0.54	High Level
Product value	4.35	0.6	High Level
Average	4.3875	0.5625	High Level

Aspects of Customer Satisfaction

This section evaluated the satisfaction of rice household users on using the rice meal machine using the 8P's marketing mix. From the data analysis, the highest customer satisfaction factor was process factor (mean = 4.48, std. deviation = 0.57), the second was physical aspect of presentation (mean = 4.37, std. deviation = 0.56), while the least was marketing promotional factors (mean = 4.19, std. deviation = 0.60). All the aspects of customer satisfaction were categorized under high level of satisfaction. The results are presented in the table below.

Descriptive Statistics			
Customer satisfaction factor	Mean	Std. Deviation	Level of satisfaction
Product factors	4.39	0.58	High Level
Price factor	4.30	0.65	High Level
Marketing promotional factors	4.19	0.60	High Level
Distribution Factors	4.24	0.65	High Level
Employee Factors	4.36	0.62	High Level
Physical aspects of presentation	4.37	0.56	High Level
Process Factors	4.48	0.57	High Level
Valid N (listwise)			High Level

Reliability and validity analysis

This section evaluated the reliability and validity status of the research. Two factors were evaluated, the customer satisfaction variable and the innovative instant rice mill machine. For reliability analysis, the Cronbach's alpha was used. The following criterion was used for evaluating reliability.

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

The Cronbach's Alpha for customer satisfaction was 0.939 while that of innovative instant rice mill machine was 0.903. This means that the internal consistency was excellent. Similarly, the composite reliability was above the cutoff point of 7.0 hence satisfactory. These findings are presented in the table below.

| Reliability Analysis				
	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Customer Satisfaction	0.939	0.948	0.95	0.732
Innovative Instant Rice Mill Machine	0.903	0.914	0.932	0.774

For the validity of variables, the discriminant validity was applied. According to (Fornell and Larcker, 1981; Hair et al., 2016), the square root of the AVE for each of the latent variables are compared with its inter-construct correlation. For the DV to hold, the square root of the AVE should be larger than the correlations with other constructs to achieve a satisfactory DV. The diagonal values should be higher than the off-diagonal values in the corresponding rows and columns. In table below, the main diagonal values are 0.856 and 0.88 which are higher than 0.714, confirming that the variables validity is satisfactory.

Discriminant Validity		
	Customer Satisfaction	Innovative Instant Rice Mill Machine

| Customer Satisfaction | 0.856 | |
| Innovative Instant Rice Mill Machine | 0.714 | 0.88 |

Effects of rice mill on customer satisfaction

The effect of innovative instant rice mill machine on the customer satisfaction as dictated by the Marketing Mix was evaluated using structural equation modelling (SEM) and the results are resented in the figure below.
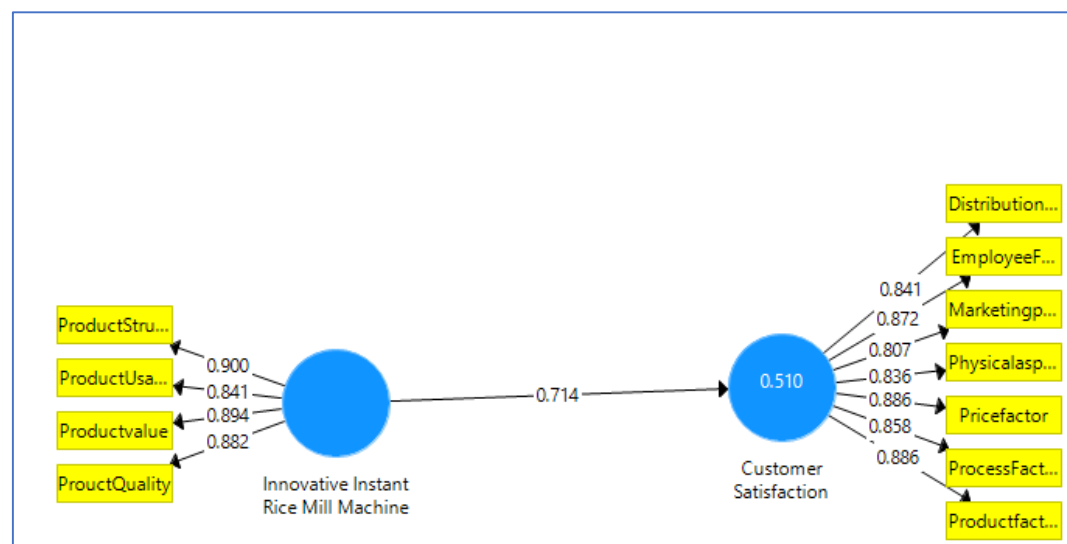
Two models are shown in above figure, the inner model, and the outer model. The inner model shows the effect of independent variable (innovative instant rice mill machine) on dependent variable (customer satisfaction). The coefficient is 0.714 which shows that innovative ready to use rice mill has 71.4 effect on customer satisfaction based on the factors included. The outer model illustrates how the observed variables affect each of the dependent and independent variables. The R-squared, as shown in the constructs is 0.510, which indicates that 51% of the variations in customers' satisfaction (8P's) are explained by the innovative ready to use rice mill. The inner model findings are summarized in the table below.

	Std. Beta	Sample Mean	Standard Deviation	T Statistics	P Values	Significance
Innovative Instant Rice Mill Machine -> Customer Satisfaction	0.714	0.716	0.039	18.244	0.000	Significant

The table above shows that innovative ready-to-use rice mill machine has a significant effect on the customers satisfaction since the p-value (0.0001) is less than 0.05. The standard beta is 0.714 which implies that a unit increase/improvement in the four aspects of innovative ready to use mill machine (structure, usability, quality, value) results to 0.714 increase in the customer satisfaction (measured by the marketing mix).

E. Effects of the Observed Variables

	Std. Beta	Sample Mean	Standard Deviation	T Statistics	P Values	Significance Level
Distribution Factors <- Customer Satisfaction	0.148	0.149	0.01	15.049	0.0001	Significant
Employee Factors <- Customer Satisfaction	0.137	0.136	0.008	16.502	0.0001	Significant
Marketing Promotional Factors <- Customer Satisfaction	0.155	0.154	0.009	16.944	0.0001	Significant
Physical Aspects of Presentation <- Customer Satisfaction	0.172	0.172	0.009	19.827	0.0001	Significant
Price Factor <- Customer Satisfaction	0.172	0.172	0.008	21.085	0.0001	Significant
Process Factors <- Customer Satisfaction	0.171	0.171	0.01	17.769	0.0001	Significant
Product Structure <- Innovative Instant Rice Mill Machine	0.29	0.29	0.012	23.589	0.0001	Significant
Product	0.228	0.228	0.014	16.529	0.0001	Significant

Usability <- Innovative Instant Rice Mill Machine						
Product Factors <- Customer Satisfaction	0.212	0.213	0.013	16.358	0.0001	Significant
Product Value <- Innovative Instant Rice Mill Machine	0.32	0.319	0.014	23.282	0.0001	Significant
Product Quality <- Innovative Instant Rice Mill Machine	0.296	0.296	0.012	24.907	0.0001	Significant

The table above shows that there were significant and positive relationship between customer satisfaction and each of customer satisfaction factors (price, process, product, distribution, employee, marketing & distribution, and physical aspect). There was also a positive and significant relationship between the innovative ready to use mill and its components, which include quality, structure, value and usability. There is also a significant relationship between the Innovative Instant Rice Mill Machine and each of its components (quality, structure, value and application).

DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS
The findings of this research have revealed significant findings regarding the new Innovative Instant Rice Mill Machine, which is suitable for use in the households. The fist important findings are that the innovative instant rice mill machine influences 71.4% of the satisfaction by the customers. At the same time, the four constructs of the innovative rice meal – its quality, its structure, its value, and its usability contributes to 51% of the satisfaction levels of rice household users, as explained by the marketing mix factors. In other words, this is a clear indication that the new machine has high potential of meeting the customers' expectations, hence suitable for the large production to be used by the household rice users. These findings are relevant as compared to the previous researches on the same field. The major objective of any particular rice-milling machine is to produce the highest quality rice grains by removing the husk and bran layer with the highest

level of efficiency. High efficiency levels are achieved through having as little breakage as possible, having the recommended moisture, as well as obtaining a high-quality finished rice product. This innovative machine has been developed and designed to achieve the highest levels of efficiency, meet the household market needs, and use the highest quality products for the highest standard levels. Another significant finding of this research worth discussing is that there were significant and positive relationship between customer satisfaction and each of its marketing mix variables (price, process, product, distribution, employee, marketing & distribution, and physical aspect). ($\beta = 0.714$ and p-value < 0.05). Additionally, each of the marketing mix factors makes a significant contribution towards the rice household user's satisfaction with the use of the machine. This is a critical observation in terms of the aspects that influence the customer's satisfaction.

Based on the above findings and discussions, several conclusions could be made regarding the ready-to-use milling machine. First, this machine is highly recommendable, as it has the capacity to meet the customer expectations. The machine has various parts such as the paddy cracker, filtration of the broken rice and whole rice are well developed. They are not only safe, but they are also easy to use and less time consuming without the need of having a professional operator. The machine accessories are easy to fix and apply, making it the most suitable rice mill to use for domestic or household purposes. It has great improvement from the previous development. The previous developed rice mill by author was costing more expensive retailing at 50,000baht and was occupying more space. However, this machine occupies less space and costs much cheaper at 15,000 baht. It also has easy to use functionalities, and make less sound when being used, hence the high ratings by the rice household users. It is also critical to note that the machine has been tested and the machine has passed various quality standards from the perspective of the customer's satisfaction.

The overall recommendation of this research is that the new ready-to-use rice mill is suitable for use by the household users. This conclusion is based on its production efficiency, and high customer satisfaction levels. The machine has a capacity to maintain the uniformity and size of the rice grains, due to its appropriate designed operation. It is designed with a light weight hence easily portable, making it convenient for the use by both small scale as well as large scale Thai rice household users. The quality of the machine is significant as it would enable the household users to produce a high-quality produce faster and with ease.

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