

# Farmer's Adoption Intention towards Eco-Innovation in Thailand

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## Abstract

There are multiple benefits to eco-innovation. As well as helping to improve sustainability and economic competitiveness at the organizational level through strategy it also has a positive impact on supply chains. There has been a trend over the past decades for both the public and private sectors to promote eco-products rather than chemical products. Still, an enormous number of hazardous chemicals continue to be used in the agricultural sector. Organic herbicides or fertilizers are alternative products, providing high economic value as well as being environmentally friendly. Unfortunately, there are some invisible barriers in the agricultural sector in Thailand to the adoption and engagement of organic or eco-innovative products. The primary objective of this research is to examine how eco-innovation can be widely adopted by major consumers in the agricultural sector in Thailand. The research results indicate that innovation characteristics play an important role in designing the marketing strategy for crossing the chasm of innovation (as suggested by Rogers, 2003). Moreover, three other moderating variables were found to significantly affect the relationship between perceived innovation characteristics and consumer adoption intention. In the analysis, the influence of perceived innovation characteristics was found to weaken when consumers have a high value-belief norm (supporting current practice or resistance to change), including the bandwagon effect (waiting until more people take up the change) and the effect of government policy on products (making it easier or cheaper to use). This research explores an alternative way to break through the barriers to adoption and enhance the engagement of organic products in the agricultural sector of Thailand.

**Keywords:** Perceived Innovation Characteristics; Value-Belief-Norm Theory; Bandwagon Effect; Government Policy; Consumers' Adoption Intention; Eco-Innovative Product

## 1. Introduction

Thailand's food and agricultural sectors not only substantially contribute to the country's GDP but also provide a traditional way of living for Thai farmers. Export figures for raw agricultural products outweigh those of value-added agricultural products (Office of Agricultural Economics-OAE, 2018). They make Thailand one of the top exporters of food and agricultural products in the region. In 2018, the country saw a decline of the selling price index as compared to 2017 (OAE, 2018). This could be due to several reasons such as the amount of products to market, limitations in new technological advances such as yard management, seedlings, and the use of inorganic pesticides and herbicides resulting in low quality production and weak bargaining power. It is indeed likely that these products are exceeding the maximum residue limit, contributing to import barriers in foreign countries and the growing social trend of not accepting inorganic agricultural products. In Thailand, an enormous number of hazardous chemicals are being used in the agricultural sector. In 2015, the country imported approximately 4,653,060 tons of various chemical fertilizers, valued at about 56,709 million baht, of which 149,546 tons or about 19,326 million baht were chemical pesticides and herbicides (OAE, 2015).

These statistics are a clear indication of the heavy consumption of chemical agricultural products by the Thai population. To tackle this situation, several supportive policies have been initiated by the Ministry of Agriculture. They include various related arena such as a learning center for efficient agricultural production, a big plantation promotion system, a proactive model of agriculture area management, the development of standardized agriculture production, new theory of agriculture under the philosophy of sufficiency economy, and the launch of the young smart farmers project. Moreover, there has been a growing trend in both the public and private sectors to promote eco-products instead of chemical ones. Organic agricultural innovation is promoted in order to reduce production costs and leverage agriculture into standard and efficient productivity (OAE, 2018)

New technologies focusing on organic eco-technology development could be adopted in the agricultural sectors. The Thai government has realized that science and technology innovation in agriculture is essential for ensuring sustainable competitiveness. In ensuring sustainability, eco-innovation can play an important role by eliminating toxicity and chemical residues as its objective is to find a more effective and sustainable way of using natural resources in order to lessen the impact on the environment. Accordingly, businesses should respond favorably to eco-innovation in order to mitigate resource scarcity and environmental degradation and ensure safe production. While challenging, switching from chemical to organic products is an extremely valuable task.

There are multiple benefits to eco-innovation. In addition to helping to improve sustainability, economic competitiveness and performance at the organizational level through strategic development, it also has a positive impact on supply chains. It forces all those involved in the value chain to incorporate life cycle and sustainability thinking into their business strategy. It also requires the coordinated adaptation of processes, goods and services, market approach and organizational framework and can create new attitudes towards environmental issues and convince farmers to switch from conventional to organic agriculture (Jiumpanyarach, 2017).

Thus, eco-products are a viable economic alternative for the future since they represent a growing portion of the total market share. Unfortunately, however, there are some invisible barriers to the adoption of organic fertilizers and other eco-innovation products used in the eco-agricultural sector in Thailand. For Thai farmers, their familiarity with chemical fertilizers, strong promotion programs, and their relative advantages are the main reasons for their rejection of organic fertilizers. According to Nualkaew (2016), there are attitude factors related to the adoption of eco-innovation. They include the government promotion of new knowledge and strategic policies. Moreover, technical issues such as product compatibility and less complexity are also important effect toward adoption of eco-innovation (Bureau of Agricultural Economics Research-B.A.E.R, 2008)

In light of the above, the purpose of this research is to analyze the correlation between perceived innovation characteristics and Thai farmers' adoption intention towards eco-innovation and determine how they can be designed to fit the requirements of potential adopters. Moreover, it aims to test the moderating role of physiological factors in the relationship between perceived innovation characteristics and consumers' adoption intention towards eco-innovative products for economic crops in the Thai agricultural sector. The outcome of this research can have strategic implications for manufacturers in the design and fit of the perceived innovation characteristics influencing the consumers' adoption intention. The ideal product will have the ability to meet the exact needs of the consumer.

## 2. Literature Review

### *- Eco-innovation*

The development of sustainable innovation is receiving increasing recognition both socially and politically, with eco-innovation coming under the umbrella of green marketing. More and more emphasis is being placed on the environmental concerns in innovation as, in an attempt to be socially responsible, firms are starting to appreciate the ramifications of their actions (Díaz-García, González-Moreno, & Sáez-Martínez, 2015). There are various definitions of eco-innovation. One encompassing definition is provided by Hemmelskamp (2000) who claims that eco-innovation is intended to avert or mitigate the environmental impact of human activities, repair the harm already inflicted or identify and investigate environmental issues. Similarly, eco-innovation may also comprise new or adapted processes, practices, systems, and products beneficial to the environment, thereby enhancing its sustainability (Oltra & Saint Jean, 2009). Moreover, it improves environmental performance (Carrillo-Hermosilla, del Río, & Könnölä, 2010). For the purpose of this research, eco-innovation can therefore be defined as innovative material that contributes its properties and is used instead of chemical products or values to enhance or promote environmentally friendly and sustainable products.

### *- Consumers' Adoption Intention*

The analysis of consumers' new product adoption behavior could benefit organizations and help them identify target audience, product placement, and strategy design (Wang, Dou, & Zhou, 2008). For this reason, the adoption of new products by consumers has been the subject of intense market research attention since buyers are fundamental to innovation expansion (Im, Bayus, & Mason, 2003). According to Rogers (2003), innovation adoption behavior can be defined as the extent to which individuals possessing similar traits adopt a new product or innovation. They can be categorized as early adopters, later adopters, and non-adopters. However, there is another middle state before consumer adoption, namely the intention to adopt, referred as consumer adoption intention.

When consumers are making a buying decision, the two important behavioral science responses are stimulation and the black box concept. There is also a using intention/purchase intention formed between the evaluation of alternatives and purchase decision (Koubaa, 2008). This supports the statement by Fishbein (1975) that purchase intention is an important factor in the prediction of consumer behavior. In this study, the researcher focuses on how perceived innovative characteristics influence farmers' adoption intention, which given their role as buyers and users of eco-innovation products in their agriculture activities, comes down to consumer's adoption intention.

### *- Socio-demographic Characteristics*

Some socio-demographic variables may contribute to explaining adopter insights, particularly concerning early adopters' characteristics. They can be influential in that they have the potential not only to drive but also to hinder the adoption of eco-innovation by consumers. They may also be interesting for segmentation purposes (Rogers, 2003). However, such influence depends to a certain extent on the framework and the kind of innovation involved. In addition, some variables might have an indirect influence on the relationship between innovation characteristics and adoption of eco-innovative products. As will be explained shortly, the value-belief-norm theory, government policy, and the bandwagon diffusion theory can explain the adoption by consumers of eco-innovative products. In this research, socio-demographic characteristics are applied as control variables.

### - *Perceived Innovation Characteristics*

The identification of successful innovation characteristics is instrumental in the design of a marketing strategy for an innovative product to cross the chasm of innovation (Rogers, 2003). Characteristics influencing consumer adoption of eco-innovation could promote the use of eco-innovative products. They create opportunities to recognize good performance and sustainable advantage during the implementation of their utilization. Intimate involvement in the eco-innovativeness concept is a way to identify the perception of consumers towards the innovation and its characteristics. Perceived innovation characteristics involve concerned assumption, whereby the attitude of potential adopters towards innovation are identified by certain components (Jansson, 2011). These comprise relative advantage, compatibility, complexity, trialability, and observability.

*Relative advantage:* Consumers, especially potential adopters, consider the advantages and disadvantages of a product according to its basic value (Kapoor, Dwivedi, & Williams, 2014). Rogers (2003) considers relative advantage as the extent to which an innovation is perceived to be superior to the original idea. The greater the innovation's perceived relative advantage, the faster its rate of adoption, as particularly evidenced by information technology innovations (Agarwal & Prasad, 1997).

*Compatibility:* New products or innovations should fit with consumer lifestyles, rather than conforming to their preference track in order to make them appealing for adoption (Rogers, 2003). Moreover, compatibility is positively associated with consumer's willingness to pay (Claudy, Michelsen, & O'Driscoll, 2011).

*Complexity:* This is perceived as the degree of difficulty involved when using a new product or innovation (Rogers, 2003). Reduction in complexity is very important for the user's adoption because if products are complicated their adoption will definitely be slower or rejected (Chou, Chen, & Wang, 2012). Thus it can be said that whereas complexity may be less important than relative advantage or compatibility for some innovations, for those expected to be used by a major market segment, complexity is likely to a substantial barrier to adoption.

*Trialability:* New innovations or products that can be distributed for trial beforehand are likely to experience more rapid adoption than those less easy to try out, especially household products (Claudy et al., 2011). Thus an innovation designed to be easily tried out will result in a faster rate of consumer adoption.

*Observability:* This has been defined as the extent to which an innovation, or its resulting adoption, is visible to others or already in use by the target market and influencers (Kapoor et al., 2014).

Related to perceived innovation characteristics, in Thailand the previous field research in rubber yard reveal that the mixed of organic and chemical fertilizers enhance higher girth in comparison with only chemical fertilizers. Moreover, only chemical fertilizer resulted in higher rubber yield but lower quality of latex and absolute dry rubber tissue quantity (Songlek, 2016). These is an example of the advantages of characteristics of organic or eco-innovation. However, this investigation only concern limited stakeholders. To accelerate the diffusion of eco-innovation, perceived innovation characteristics should be implemented as a key strategic marketing factor. Thus the first hypothesis concerning eco-innovation adoption has been developed as follows:

**H<sub>1</sub>:** *Perceived innovation characteristics are positively associated with consumer's adoption intention.*

### **- Value-Belief-Norm Theory**

Various studies have focused on the differing values of individual consumers and their behavior regarding early adoption (e.g. Daghfous, Petrof, & Pons, 1999). Consumer values can be defined as being perceptively rather than objectively driven by externalities (Corfman, Lehmann, & Narayanan, 1991). Consequently, in the analysis of consumer adoption, attitudes and values are crucial and should be carefully considered when reaching a conclusion. Values, beliefs, and norms have a causal relationship with environmentally significant behaviour (Stern, 2000).

This research, therefore, employs the value-beliefs-norm theory to explain the influence of pro-environmental values on behaviour (Dietz, Stern, & Guagnano, 1998). Meanwhile, in Thailand there are evidence about investigating the changes in farmers' lifestyles and value after completion of the Sufficiency Economy Training Program which aim to build better farmer quality of life and wealth level. The result revealed the positive change among farmers especially the significant reduction of chemical fertilizers and herbicides for their plantations (Sangsuriyajan, 2010). Thus the second hypothesis concerns the adoption of eco-innovation.

**H<sub>2</sub>:** *The value-belief-norm moderates the relationship between perceived innovation characteristics and consumers' adoption intention towards eco-innovative products.*

### **- Bandwagon Effect Theory**

Since the 'bandwagon' effect on consumer choice was recognized by Leibenstein (1950), there has been a considerable amount of recent literature on the analysis of consumer choice among conflicting brands under positive network externalities (e.g. David & Greenstein, 1990). However, it can be argued that when analyzing the beneficial effects of a greater number of consumers favoring a particular brand, consumers do not necessarily place greater value on it when purchasing a comparable or indistinguishable brand. This is because an extensive analysis of the benefits requires the development of a model in which consumer tastes are taken into account and disseminated rather than assumed. In the model exhibited by Abrahamson and Rosenkopf (1993), the bandwagon effect takes place at the institutional level.

Two types of bandwagon pressures were found to encourage simulation: institutional pressure, which arises from social acceptance, and competitive pressure, which arises from the risk of reduced competitive advantage. It can therefore be argued that an organization will tend to adopt an innovation due to the fear of lost legitimacy and stakeholder support, and to retain competitive advantage, even if it may not be profitable to do so (Abrahamson & Rosenkopf, 1993; Pennings & Harianto, 1992; Wade, 1995). In Thailand, the bandwagon effect also has been found in the rubber sector that is the most important economic crop in the Southern region. Farmers seem to select fertilizers mostly due to high recommendations from their neighbors rather than from academic adoption (Onthong, 2013). The third hypothesis, therefore, concerns the adoption of eco-innovation.

**H<sub>3</sub>:** *The bandwagon effect moderates the relationship between perceived innovation characteristics and consumer's adoption intention towards eco-innovative products.*

### **- Government Policy**

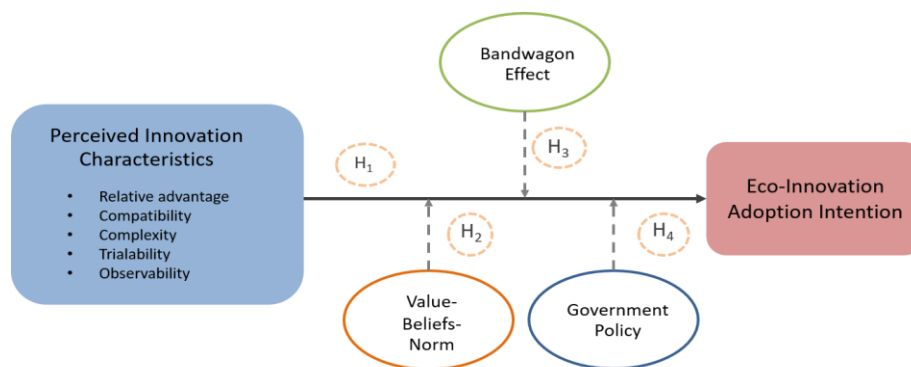
It is recognized that government policy plays a role in promoting and enhancing the adoption of innovation. Chung (2013) mentioned that government organizations have a strong influence on external stakeholder capability regarding the undertaking of consistent and appropriate research, technology development, and innovation policies, including adoption promotion. In relation to Europe, greater regional public action is required to promote the transmission of knowledge than that necessary to control the disproportionate dissemination of externalities seemingly responsible for reducing the incentive of the private sector towards innovation

(Autant-Bernard, Fadairo, & Massard, 2013). In the agricultural sector, government policy plays a role in national research, technology, development, and innovation, providing an analytical framework for consistent and appropriate RTDI policies to promote innovation system development.

Previous research on Thailand shows that the lack of government role in research support and funding for organic fertilizers acts to decelerate the adoption of organic fertilizers. Moreover, the lack of sufficient training for the dissemination of knowledge about organic agriculture innovation application influences the rate of organic agriculture innovation adoption (Somsrisai, 2009). So, in emphasizing innovation diffusion, the researcher believes that policies should be put in place to influence innovation adoption. Thus, the fourth hypothesis concerning eco-innovation adoption has been developed as follows:

**H4:** *Government policy moderates the relationship between perceived innovation characteristics and consumer's adoption intention towards eco-innovative products.*

### 3. Methodology



**Figure 1:** Theoretical Research Framework (Compiled by author for this study)

A quantitative research methodology is used in this study for the collection, analysis, and integration of experiments and surveys, with close-ended questions to measure attitude (rating scales) and behavior. This type of data is statistically analysed by collecting the scores from the questionnaires to answer the research questions or for testing the hypotheses.

#### **- Research Design and Data Collection**

In order to understand the attitude of respondents towards the adoption of eco-innovative products in the agricultural sector, this study follows a quantitative approach. Descriptive research provides further insights into previous studies with the inclusion of possible moderating variables affecting the relationship between influencing factors and adoption intention. A self-administered survey was used to collect data through a list of qualifying stakeholders in the agricultural sector via the local office of the Thai Department of Agriculture.

#### **- Population, Sample Design, and Sample Size**

In this research, the population consists of potential economic crop planters who are encouraged to join together to produce quality goods and focus on key export products, with the objective of increasing productivity and quality, reducing chemical residues during the manufacturing process, and promoting sustainable competitiveness.

Multi-stage sampling was employed. During the primary stage, sample members were identified in relation to key economic crops - rubber, oil palm, rice and fruit and vegetable. In the second stage, to obtain a workable group, the number of respondents were determined by convenience sampling for each type of economic crops relevant to potential respondents as consumers of innovative eco-products. G\*Power is a free power analysis program for a variety of statistical tests including the domain of correlation and regression analyses (Faul, Erdfelder, Buchner, & Lang, 2009). So this research employed G\*Power to estimate the sample size by  $F^2 = 0.15$  (medium) err prob = 0.05 number of predictors = 10. Therefore, the total respondent of 172 is estimated sample size as a country overview.

#### **- Research Instrument**

*Questionnaire Design.* A structured questionnaire was designed to collect data from respondents in order to achieve the objectives. A five-point Likert scale was adopted for the questionnaire with a range of options from 'strongly disagree' to 'strongly agree', and 'moderately disagree' and 'moderately agree', with 'neutral' for the middle scale. This questionnaire consisted of five parts and 31 statements, 26 of which have been used previously by other researchers (Jansson, 2011; Jansson, Marell, & Nordlund, 2011). Some of the variables in the five statements developed for this study were selected from the perceived innovative characteristics. Convenience sampling was used for sample selection in this study. The respondents are farmers operating in rice, rubber, fruit & vegetable and oil palm agriculture in overall region of Thailand.

#### **- Variables and Measures**

*Independent Variables.* Perceived innovation characteristics are the independent variables in this study. Perception and attitude were measured using a five-point rating scale to ascertain agreement with the 16 statements adapted from Jansson (2011).

*Dependent Variable.* Adoption intention is the dependent variable. Statements in the questionnaire include: "I am interested in agricultural innovative organic products", "I am interested in using agricultural innovative organic products", "I am reducing my use of chemical herbicides and fertilizers and would not mind changing to agricultural innovative organic herbicides and fertilizers", "I will suggest other people to use agricultural innovative organic products", and "I am aware of a better quality of life when using agricultural innovative organic products". Answers to the questions were measured using a five-point scale of agreement (H.-J. Lee & Yun, 2015).

*Moderating Variables.* The value-belief-norm is the first moderating variable, consisting of three minor components (Jansson et al., 2011). Six statements were used, and a five-point rating scale applied to measure agreement. The second moderating variable is the bandwagon effect. The three questions are designed on the basis of the bandwagon effect theory (J. Y. Lee & Chan, 2003) applying a five-point scale rating measurement. Finally, the moderating variable of government policy was applied, consisting of three questions (Chung, 2013).

*Control Variables.* In this research, the respondents' socio-demographics such as gender, age, education, income, recipient of government funding, and government advisers are measured as control variables (Rogers, 2003). The respondents' socio-demographics are measured using a nominal scale but not taken into account in hypothesis testing.

#### **- Validity and Reliability**

In this research, the quality of the data collected was measured for reliability and validity with the implementation of SPSS which assesses measurement properties. To assess the construct validity, a test factor analysis was conducted with the scale accuracy technique adopted for

reducing the set of observable variables. The Cronbach's alpha coefficient was used to measure reliability with values ranging value from 0 to 1 (a value of 0.60 is acceptable, while 0.80 or higher indicates greater reliability). The specific scale items for the variables are listed in Table 1.

**Table 1:** Scale Items, Item Loading, and Reliability of Relative Advantage

Item Scale	Item Loading	Reliability( $\alpha$ )
Relative Advantage	4	0.828
Compatibility	3	0.793
Complexity	3	0.714
Trialability	3	0.781
Observability	3	0.767
Value-Belief-Norm	6	0.821
Bandwagon Effect	3	0.771
Government Policy	3	0.754
Consumer's Adoption Intention	5	0.784

To confirm its validity the questionnaire was distributed to specialized personnel using questions arising from the literature review. Content validity was determined based on the mean content-related evidence. Content-related evidence indicates the level of testing or that the questions contained in the questionnaire are covered by the required sample behavioral boundaries selected for measurement (Anastasi, 1982). The index of item-objective congruence (IOC) was considered by one specialist in the field, and two academics using the formula:

$$IOC = \frac{\sum R}{N}$$

Where R means the opinion of a specialist in which +1 = sure of consistency, 0 not sure of consistency and -1 sure of inconsistency. The specialists were satisfied with the questions listed in the questionnaire.

**- Method of Analysis**

A hierarchical regression analysis was conducted in order to test the hypotheses. Firstly, perceived innovation characteristics and consumers' adoption intention were introduced into regression as the main research variables to measure the relationship between two variables following Hypothesis 1 and analyze its independent variable sub-domains. Secondly, the value-belief-norm was set as the first moderator for analyzing Hypothesis 2. Thirdly, the bandwagon effect was used as the second moderator in Hypothesis 2. Finally, government policy was entered as the last moderator for analyzing Hypothesis 4. The moderated regression analysis technique was implemented to test whether the relationship between perceived innovation characteristics and consumers' adoption intention was moderated by the value-belief-norm, bandwagon effect, and government policy.



#### 4. Research Findings

In this research a survey was used for data collection through questionnaires interviews in the agricultural areas in overall regions of Thailand. The total of 179 samples consists of both men and women in the agricultural sector. The SPSS was employed to analyze the raw data through descriptive statistics, correlation analysis, reliability analysis, and regression analysis, with the results divided into two parts as follows.

Part 1: Demographics

Part 2: Research Analysis and Hypothesis Testing

##### - Demographics

The demographic characteristics of the respondents consist of gender, age, education, educational major, job level, and personal income.

**Table 2:** Demographic Characteristics of Respondents (n=179)

Characteristics		Frequency
Gender	Male	58
	Female	121
Age	21–25	12
	26–30	4
	31–35	51
	36–40	7
	41–45	1
	Older than 45	104
Education	Primary	32
	Secondary	25
	Bachelor degree	87
	Higher than bachelor degree	35
Income/year	Less than 20,000	32
	20,001–35,000	37
	35,001–50,000	23
	50,001–65,000	17
	65,001–80,000	19
	More than 80,000	51
Type of Agriculture	Rice	43*
	Rubber	168*
	Oil palm	63*
	Fruit and vegetables	17*

\*type of agriculture can be repeatable in one farmer

According to Table 2, most respondents are females (67.6%), while 32.4 percent of the respondents are males. The majority of the respondents are 45 years or older (58.1%), followed by those aged between 31–35 and 21–25 at 28.5% and 6.7%, respectively. Only 3.9 percent of them are aged between 36–40. As to education, 48.8 percent of the respondents have a bachelor's degree, 19 percent hold a master's degree or higher level of education with 14 percent completing secondary school. The highest percentage of personal income is found in the group earning more than 80,000 baht (28.5%), whereas respondents with an income of between 50,001–65,000 baht per year are in the lowest percentage group (9.5%). Of the

remaining respondents, 17.9 percent have a personal income of 20,000 baht or less, 20.7 percent earn 20,001–35,000 baht, 12.8 percent earn 35,001–50,000, and 10.6 percent earn 65,001–80,000. Lastly, regarding agricultural type, 57.7 percent of the respondents operate in the rubber sector and the remainder deal with palm oil and rice (21.6% and 14.8%, respectively) with 5.8 percent growing fruit and vegetables.

#### ***- Research Analysis and Hypothesis Testing***

This study employs descriptive statistics for explaining consumer's attitude then regression analysis for testing hypotheses H1, H2, H3, and H4. These hypotheses are formulated to clarify the relationship between perceived innovation characteristics, value-belief-norm, bandwagon effect, and government policy and the consumers' adoption intention towards agricultural innovative products.

**Table 3:** Results of Descriptive Analysis for Consumer's Attitude

<b>Factor</b>	<b>Mean</b>	<b>SD.</b>
<b>Independent Variables</b>		
Relative Advantage	4.61	0.577
Compatibility	4.78	0.415
Complexity	4.53	0.733
Trialability	4.22	0.883
Observability	4.82	0.385
<b>Moderating Variables</b>		
Value-Belief-Norm	4.71	0.504
Bandwagon Effect	4.31	0.583
Government Policy	4.82	0.389
<b>Dependent Variable</b>		
Adoption Intention	4.60	0.471

The descriptive statistics shown in Table 3 show the attitude of economic crops farmers toward operational variables in the research. The highest score among the independent variable is Observability at 4.82, followed by Compatibility at 4.53. The lowest score is Trialability at 4.22. The strongest attitude toward the moderating variables is 4.82 which is Government Policy. As the dependent variable, Adoption Intention scores high at 4.60.

**Table 4:** Results of Hierarchical Regression Analysis for Consumers' Adoption Intention

Variables	Model 1	H1 Model 2	H2 Model 3VBN	H3 Model 4: BWE	H4 Model 5: GP
<b>Step 1: Control</b>					
Gender	0.482	0.000*	0.373	0.001*	0.001*
Age	0.567	0.389	0.009*	0.000*	0.000*
Education	0.000*	0.000*	0.002*	0.262	0.324
Income	0.151	0.137	0.841	0.016**	0.050
Government funding recipient	0.085	0.001*	0.000*	0.063	0.000*
Government adviser	0.083	0.000*	0.009*	0.001*	0.076
<b>Step2: Independent variable</b>					
Relative advantage		0.000*			
Compatibility		0.000*			
Complexity		0.000*			
Trialability		0.000*			
Observability		0.003*			
<b>Step 3: Moderator</b>					
Value-belief-norm			0.001		
Bandwagon effect				0.000	
Government policy					0.000
<b>Step 4: Interaction terms</b>					
RA x VBN			0.029**		
Complexity x VBN			0.000*		
Compatibility x VBN			0.000*		
Trialability x VBN			0.000*		
Observability x VBN			0.078		
RA x BWE				0.139	
Complexity x BWE				0.000*	
Compatibility x BWE				0.005*	
Trialability x BWE				0.000*	
Observability x BWE				0.029**	
RA x GP					0.000*
Complexity x GP					0.000*
Compatibility x GP					0.000*
Trialability x GP					0.000*
Observability x GP					0.056
R <sup>2</sup>	0.244	0.680	0.750	0.760	0.683
Adjust R <sup>2</sup>	0.218	0.671	0.743	0.753	0.673
F-Statistic	9.261	73.482	104.059	109.445	74.409

Notes: \*, \*\* Significant at 1% and 5% confidence level, respectively

**- Study 1**

Study 1 investigates the importance of perceived innovation characteristics associated with consumers' adoption intention, with the results tested as Hypothesis 1. As indicated in Table 3, the regression model 2 shows that the characteristics of perceived innovation namely relative advantage, compatibility, complexity, trialability, and observability are significant at a 95% confidence level. This means that the respondents are likely to adopt eco-innovative products when recognizing their highly positive innovation characteristics. These results are similar to those of Jansson (2011), who demonstrated that perceived innovation characteristics and consumers' adoption intention have a positive relationship.

It can be concluded that to enhance the diffusion gradient of eco-innovative products, perceived innovation characteristics should be implemented during the design process. Apart from these, there are three more variables to be considered, namely value-belief-norm, bandwagon effect, and government policy. These moderating variables are studied in the next section to investigate the relationship between perceived innovation characteristics and consumers' adoption intention.

**- Study 2**

This study investigates the moderating effect of value-belief-norm factors in the relationship between perceived innovation characteristics and consumers' adoption intention. In Table 4, the regression shows significant interaction between perceived innovation characteristics and value-belief-norm in consumers' adoption intention. Overall, a 95% confidence level is indicated for relative advantage, compatibility, complexity, and trialability ( $p = 0.029, 0.000, 0.000, \text{ and } 0.000$ , respectively), with observability being insignificant ( $p = 0.078$ ). Observability alone is not affected by the value-belief-norm.

The value-belief-norm heavily influences the relationship between perceived innovation characteristics (excluding observability) and consumers' adoption intention. Observability represents product availability in the market—less experience of the product on the market results in less adoption. Thus, it is strongly recommended that value-belief-norm factors are included in market development and product adoption strategies.

**- Study 3**

In study 3 the bandwagon effect is adopted as the second moderating variable. Recall from above that the bandwagon effect is a psychological phenomenon whereby individuals do something primarily because others are doing it, regardless of their own beliefs. According to the regression model, interaction between perceived innovation characteristics and the bandwagon effect in consumers' adoption intention are significant at a 95% confidence level ( $p = 0.139, 0.000, 0.005, 0.000, \text{ and } 0.029$ , respectively). However, relative advantage alone is insignificant ( $p = 0.139$ ).

The bandwagon effect influences the relationship between perceived innovation characteristics and consumers' adoption intention. It can be said that consumers are less likely to be interested in the perceived innovation characteristics (excluding relative advantage) when they experience a strong bandwagon effect towards the product. However, the bandwagon effect is not influenced by relative advantage. Relative advantage concerning the product is still an important factor as can be explained by the researcher.

**- Study 4**

Study 4 investigates the influence of interaction between perceived innovation characteristics, and government policy towards consumers' adoption intention. The results indicate a 95% confidence level for relative advantage, compatibility, complexity, and trialability ( $p = 0.000$ ,

0.000, 0.000, and 0.000, respectively), and insignificance for observability ( $p = 0.056$ ). Observability alone is not affected by government policy.

Perceived innovation characteristics should be designed in accordance with current product-related government policy. It is strongly recommended that government policy factors are included in market development and product adoption strategies since compliance with government policy can enhance the level of product adoption intention. However, government policy does not influence observability. In particular, product availability or results from its use are very important.

## 5. Discussion and Concluding Remarks

As the results indicate, perceived innovation characteristics continue to impact strongly on the intention of consumers to adopt agricultural eco-products. As eco-innovative product consumers, Thai farmers are aware of perceived innovation characteristics and have a positive perception of them, which affects their adoption intention (Kapoor et al., 2014). The more positive the perceived innovation characteristics, the more likely they will buy the products (Rogers, 2003). However, the positive effect of perceived innovation characteristics in the research findings can be weakened by other factors such as value-belief-norm, the bandwagon effect, and government policy. The most powerful moderating factor here is the bandwagon effect since it has the highest coefficient score for sub-variable relative advantage (0.139).

This research contributes to the understanding of factors motivating consumers to buy products with positively perceived innovation characteristics since these affect their adoption intention towards eco-innovative agricultural products in Thailand. From the findings, it can be concluded that the effect of the value-belief-norm, bandwagon effect, and government policy have a greater impact on the awareness of consumers towards the perceived innovation characteristics of their adoption intention. In other words, consumers are less likely to be interested in perceived innovation characteristics when experiencing a greater impact from the value-belief-norm, bandwagon effect, and government policy. This shows that physiological and marketing factors should be considered as well as perceived innovation characteristics during the product development and planning process. The researchers suggest that the physiological factors related to a product such as the value-belief-norm, bandwagon effect, and government policy can moderate the relationship between perceived innovation characteristics and consumers' adoption intention.

Meanwhile, it is hypothesized that perceived innovation characteristics significantly influence consumers' adoption intention. However, such significance is reduced when consumers are influenced by a strong value-belief-norm, the bandwagon effect, and government policy. The findings indicate that these three variables affect the relationship between perceived innovation characteristics and consumers' adoption intention towards products. In particular, this research provides better understanding regarding the factors influencing consumers' adoption intention, as well as contributing academically and strategically to private sector development and the commercialization of organic innovation product alternatives for use in agriculture.

When taking a deeper look at each variable interaction, statistics show that eco-innovative products tend to be widely adopted by major consumers when the strategic variables are optimized and implemented by manufacturing company as a spring board to bridge the chasm of product adoption (Jansson, 2011) and supported by governments as part of promoting adoption of eco-innovation among Thai farmers. This research is expected to contribute towards greater economic value for stakeholders in the agricultural sector, opening a new chapter in the development of this sector in Thailand.

***- Implications for Researchers***

Previous research on perceived innovation characteristics tends to include relative advantages, compatibility, complexity, trialability, and observability. However, as mentioned by Jansson et al. (2011) and J. Y. Lee and Chan (2003), the relative multidimensional effect of perceived innovation characteristics influence product adoption intention with differing levels of value-belief-norm and bandwagon effect. Meanwhile, Chung (2013) also argues that the impact of government policy is more important when products are perceived according to their characteristics. The results of this current study indicate that the value-belief-norm, bandwagon effect, and government policy moderate the relationship between perceived innovation characteristics and consumers' adoption intention. Thus, it is recommended that researchers in this area include the value-belief-norm, bandwagon effect, and government policy as moderating variables when considering the relationship between perceived innovation characteristics and consumers' adoption intention.

***- Implications for Practitioners***

The research findings have strategic implications for manufacturers wishing to design a model with positively perceived innovation characteristics to influence consumers' adoption intention. The results of this research indicate that perceived innovation characteristics still have a strong positive impact on Thai consumers' adoption intention towards agricultural eco-products. However, this relationship is also influenced by the value-belief-norm, bandwagon effect, and government policy.

To take advantage of perceived innovation characteristics in product design and gain greater consumer confidence, manufacturers should recognize the four influential components, namely relative advantage, compatibility, trialability, and observability, while simultaneously focusing on introducing less complex products. However, in this study, this type of product sometimes has an indirect effect on moderating the relationship of perceived innovation characteristics and consumers' adoption intention. Manufacturers need to be aware of these variables in order to implement the correct strategy, save resources, and design an appropriate product.

In studying the value-belief-norm, manufacturers should be aware of incorrect values for existing related products which might affect new products to enhance consumer confidence. For the bandwagon effect, manufacturers and stores must listen to customers' views and implement their strategy accordingly when launching the product. Moreover, as indicated by this research, government policy should also be taken into account since consumers are likely to be more willing to purchase products which are in agreement with government policies and guidelines. In following these practical steps, manufacturers can therefore design products by deploying the regulations and policies of their respective countries.

***- Limitations***

The limitations of this research relate to the data collection and the length of time required for completion of the questionnaires. This issue was exacerbated by the level of cognition of some respondents, resulting in the number of questionnaires just meeting the minimum sample size requirements and not equally distribute to all economic crops of Thailand, which means that this paper could not consider each single type of crop.

***- Future Research***

Since this research focuses only on perceived innovation characteristics and consumers' adoption intention, it is not absolutely conclusive that consumers will adopt and use the products. In order to make the research more general and provide greater understanding of eco-

innovative products in the agricultural sector, future research should expand into the adoption phase. This would enable the design and fit of a potential model for eco-innovative product adoption in the agricultural sector in Thailand to be thoroughly tested. Moreover, future research might expand to interesting single type of economic crop where some unique pertinent issues might be investigated. Last but not least, this research employed socio-demographic factors as a control variable but not as the objective of the research. Thus, socio-demographic variables could be recommended as the main focus of future research.

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