

## PROPOSED CONCEPTUAL FRAMEWORK FOR STUDYING NON-USERS RICE FARMERS' INTENTION TO USE COMMERCIAL BIOPESTICIDES PRODUCTS

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### Abstract

Commercial biopesticide products have been developed for a long time in Indonesia, but until now the level of application is still relatively low. This paper aims to determine the factors that are expected to influence the intention of non-users rice farmers to use commercial biopesticide products. Furthermore, a conceptual framework of intention to use commercial biopesticide products is proposed. Based on the literature review of previous empirical studies in various contexts, this paper has explored the factors that influence the intention of using biopesticides. Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) is employed as the main theoretical basis in this study which can be extended with relevant constructs to the research context (extended UTAUT2). The proposed conceptual framework recommends that non-users rice farmers' intention to use commercial biopesticide products is expected to be influenced by variables namely performance expectancy, effort expectancy, social influence, facilitating condition, price value, perceived need, information publicity, and product marketing. This integrative conceptual framework is expected to have a theoretical contribution to understand the factors of non-users rice farmers' intention to use commercial biopesticide products. In addition, it is beneficial for policymakers and managers to formulate and implement strategies to increase rice farmers' intention to use commercial biopesticide products.

### Abstrak

Produk biopestisida komersial sudah dikembangkan sejak lama di Indonesia, namun hingga saat ini tingkat penerapannya masih relatif rendah. Tujuan dari makalah ini adalah untuk mengetahui faktor-faktor yang diduga memengaruhi niat petani padi yang bukan pengguna untuk menggunakan produk biopestisida komersial. Selanjutnya, diusulkan sebuah kerangka konseptual mengenai niat untuk menggunakan produk biopestisida komersial. Berdasarkan tinjauan literatur terhadap penelitian terdahulu di berbagai konteks, makalah ini mengeksplorasi faktor-faktor yang berpengaruh terhadap niat penggunaan biopestisida. Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) digunakan sebagai landasan teori utama dalam penelitian ini yang diperluas dengan konstruk yang relevan dengan konteks penelitian (extended UTAUT2). Kerangka konseptual yang diusulkan ini merekomendasikan bahwa niat petani padi yang bukan pengguna untuk menggunakan produk biopestisida komersial diharapkan akan dipengaruhi oleh variabel yaitu kinerja yang diharapkan, usaha yang diharapkan, pengaruh sosial, kondisi yang memfasilitasi, nilai harga, kebutuhan yang dirasakan, sosialisasi informasi, dan pemasaran produk. Kerangka konseptual yang terintegrasi ini diharapkan dapat memiliki kontribusi teoritis dalam memberikan pemahaman yang komprehensif tentang faktor-faktor penentu niat petani padi yang bukan pengguna untuk menggunakan produk biopestisida komersial. Bagi pembuat kebijakan dan manajer perusahaan maka dapat bermanfaat untuk merumuskan dan menerapkan strategi guna meningkatkan niat petani padi untuk menggunakan produk biopestisida komersial.

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## INTRODUCTION

The use of synthetic pesticides is still widely applied to control plant-disturbing organisms in the agricultural sector in many countries. However, many previous research results showed the negative impacts due to the unwise use of synthetic pesticides, including environmental damage and health problems for humans and other living creatures (Macharia et al., 2013; Wilson & Tisdell, 2001). Biopesticide is an alternative plant protection technology that is environmentally friendly. Biopesticides are materials derived from living things (plants, animals, or microorganisms) that can inhibit the development or even kill plant-disturbing organisms (Sumartini, 2016). The prospect of the biopesticide business in Indonesia is promising. The potential for biopesticide development in Indonesia is very considerable, due to Indonesia is a mega biodiversity country with abundant species of plants and microorganisms that can be used as agents for controlling plant-disturbing organisms, as well as biopesticide research by the private sector, government, and universities. In addition, the domestic biopesticide industries also have the capacity to produce various types of commercial biopesticide products. On the other hand, public awareness of a healthy lifestyle has led to an increase in demand for organic or residue-free products. Consumers are willing to pay higher price for these residue-free products (Fathia et al., 2018). International trade in many countries has also imposed a policy of Maximum Residue Levels of synthetic pesticides on agricultural products. The Indonesian government also supports the control of plant-disturbing organisms with an environmentally friendly approach on a massive scale through the implementation of various programs using biopesticides as one of the introduced technology components.

Biopesticide as an alternative technology for environmentally friendly plant protection is not a completely new technology. However, Indonesia is still facing problems that the level of application of biopesticides is still relatively low and the market share is still relatively small. Previous studies found that the level of application of biopesticides by farmers participating in the Integrated Pest Management Farmer Field School (IPM-FFS) in South Lampung was less than 10% (Astuti et al., 2013) and by farmer respondents in Mojogedang 33.3% (Prabayanti, 2010). In addition, the market share of biopesticides in Indonesia is relatively small, which is estimated at 6.8% of the total volume of the pesticide market (Mordor Intelligence, 2023). According to a report from Markets and Markets (2020), the growth of the world's biopesticide market is estimated to increase from 4.3 billion USD in 2020 to 8.5 billion USD in 2025 with an average growth rate of 14.7% per year. The first step in planning efforts to increase the use of biopesticides is to understand the intention of farmers to use biopesticides in their farming. Meanwhile, regarding the issue of the relatively small market for biopesticides in Indonesia, efforts are needed to increase user acceptance of commercial biopesticide products to support the development of the national biopesticide industry.

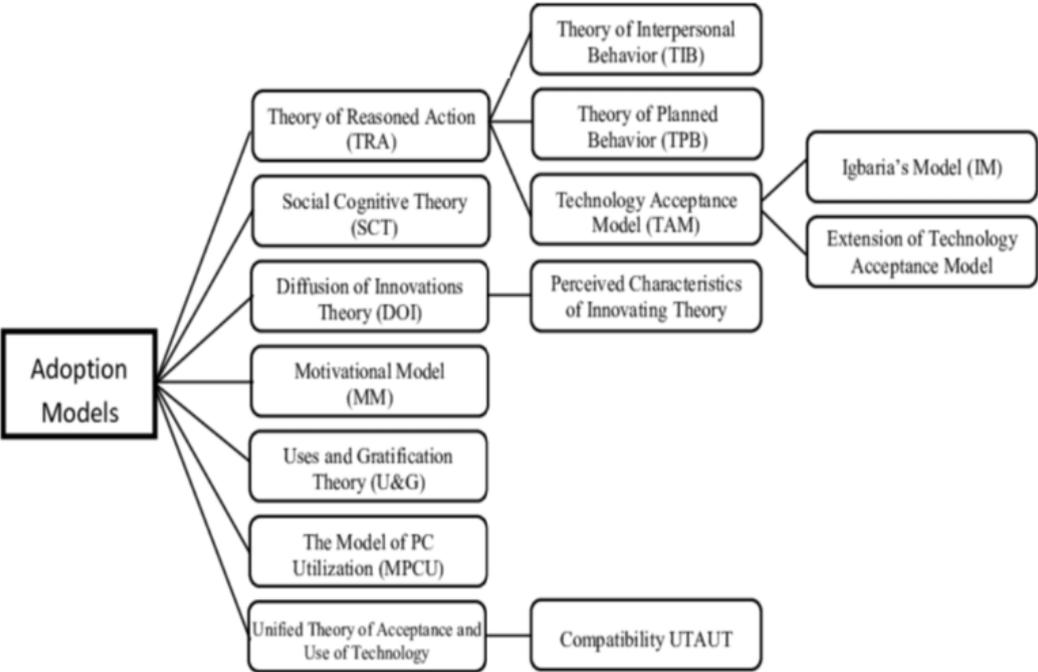
Previous empirical studies on the intention to use biopesticides have been carried out using various models and theories that can explain the attitude, intention, and behavior of individuals towards technology use, such as the Theory of Planned Behavior (TPB) (Izdihar, 2012), Diffusions of Innovations (DOI) (Prabayanti, 2010; Tarukallo et al., 2014), integration of the Technology Acceptance Model (TAM) and DOI (Sharifzadeh et al., 2017), integration of DOI, TPB and TAM (Abdollahzadeh et al., 2017), and integration of TPB and the Health Belief Model (HBM) (Ataei et al., 2021). However, research on the intention of non-users farmers to use commercial biopesticide products using the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (Venkatesh et al., 2012) is still limited. Therefore the present study aims to address this issue. This research will fill the gap by formulating variables that comprehensively influence non-users farmers' intention to use commercial biopesticide products. To gain a better understanding of the phenomenon of technology use, UTAUT2 as the main theoretical basis in developing the conceptual framework can be extended with constructs that are relevant to the research context (extended UTAUT2) (Venkatesh et al., 2012) which aims to increase the predictive power of the model. This research will build a framework that integrates theories that are relevant to the problem of this research, so that variables can be determined that are predicted to influence farmers' intentions to use commercial biopesticide products.

The research will focus on the behavior of rice farmers who are not users of commercial biopesticide products, however, they have already known information about commercial biopesticide products. Whereas the determination of rice commodity for this study is the consideration that rice is a strategic commodity and a staple food for the majority of the population in Indonesia. Most farmers in Indonesia cultivate rice as the main commodity, and programs that introduce biopesticides to rice farmers on a large scale have been carried out in recent years. In relation to the formulation of the research problem, the research questions that will be studied further in this study are (1) what variables that influence non-users rice farmers' intention to use commercial biopesticide products?, and (2) how is the structural model of the non-users rice farmer's intention to use commercial biopesticide products?. Based on these reasons, the authors are interested in developing a conceptual framework regarding the factors that influence the intention to use commercial biopesticide products. The purpose of this paper is to determine the factors that are expected to influence the intention of non-users rice farmers to use commercial biopesticide products. Furthermore, a conceptual framework of intention to use commercial biopesticide products by utilizing the extended UTAUT2 is proposed. This integrative conceptual framework is expected to have a theoretical contribution to understanding the factors of non-users rice farmers' intention to use commercial biopesticide products. In addition, it will also be beneficial for policymakers and managers to formulate and implement strategies to increase rice farmers' intention to use commercial biopesticide products.

**LITERATURE REVIEW**

*The Concept of UTAUT2*

According to Rogers (2003) “adoption is a decision to make full use of an innovation as the best course of action available”. Technology adoption is a process that begins with awareness of a technology and then makes full use of that technology (Renaud & Van Biljon, 2008). Most studies on technology adoption are based on individual behavioral intentions (Khan & Qudrat-ullah, 2021). According to Amini et al. (2021), during the last five decades experts have developed a variety of different theories and models to study the process of adopting new technologies (Figure 1).

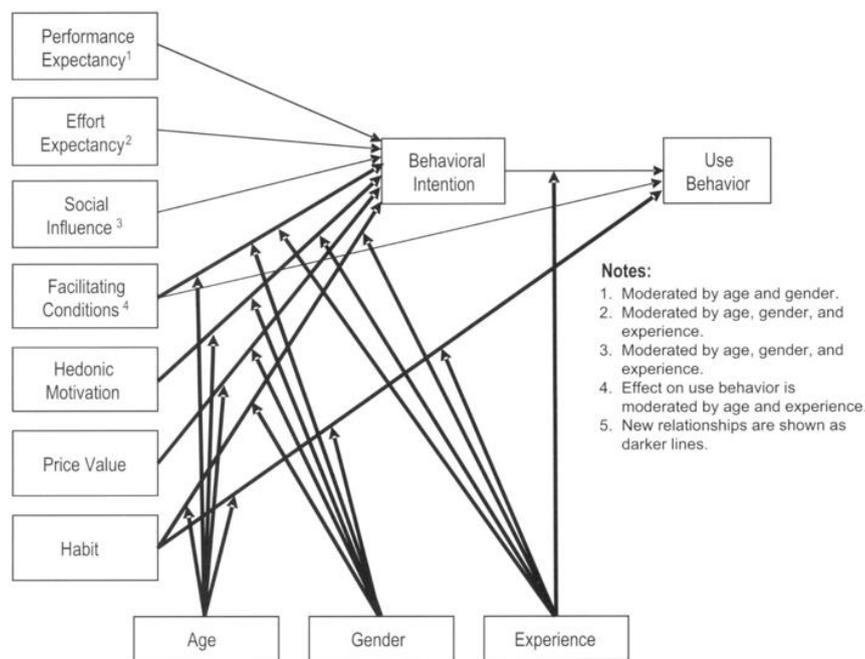


**Figure 1. Different Types of Adoption Model**

Source: Amini et al. (2021)

These various models and theories can explain individual behavior towards technology adoption. The purpose of these theories and models is to provide a concept of individual acceptance of technology and demonstrate the individual's ability to adopt new technologies based on behavioral science concepts in psychology and sociology.

These theories have been developed over the years and resulted from the expansion of each other, including the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975), the theory of planned behavior (TPB) (Ajzen, 1991), the technology acceptance model (TAM) (Davis, 1986), and the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003). Venkatesh et al. (2003) reviewed, mapped, and integrated the constructs of eight theories and models, namely TRA, TPB, TAM, motivational model (MM), a combined TPB-TAM model (C-TPB-TAM), model of PC utilization (MPCU), innovation diffusion theory (IDT), and social cognitive theory (SCT) and then they further formulated UTAUT. Venkatesh et al. (2003) designed the UTAUT model to gain a comprehensive understanding and prediction of user behavior that was not achieved individually by previous models. According to Dwivedi et al. (2011), UTAUT was developed as a theoretical advance over previously existing theories used in research related to adoption and diffusion. UTAUT was developed by Venkatesh et al. (2003) for application in organizational contexts, but UTAUT has also been successfully applied in various technological contexts both within organizations and non-organizations. UTAUT was further developed by Venkatesh et al. (2012) into UTAUT2 to study the acceptance and use of technology in a consumer context.



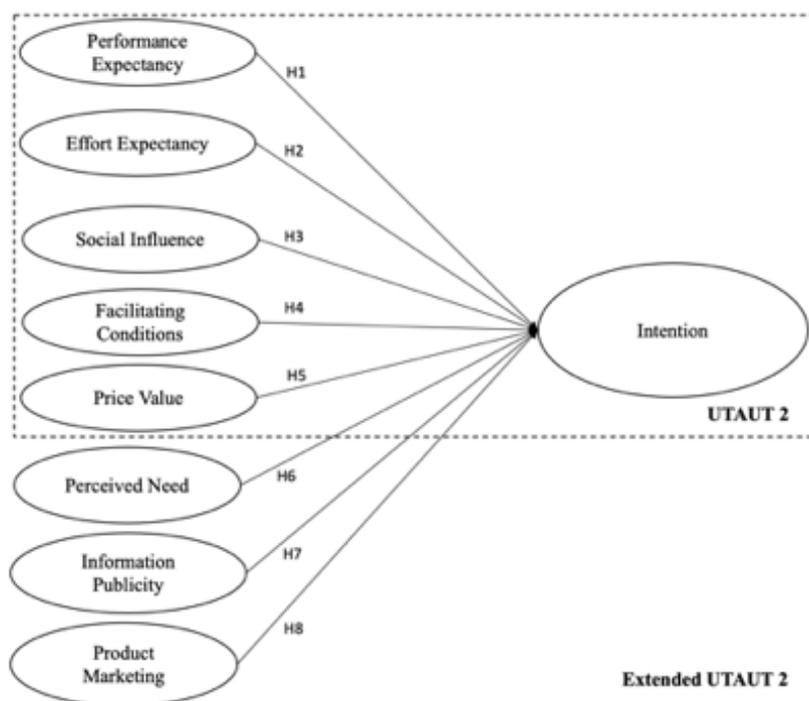
**Figure 2. UTAUT2**  
Source: Venkatesh et al. (2012)

UTAUT2 will be used as the main theoretical basis to develop the conceptual framework regarding the factors that influence the farmer's intention to use commercial biopesticide products, with the argument that UTAUT2 was developed by Venkatesh et al. (2012) to study the acceptance and use of technology in a consumer context. In addition, UTAUT2 is a robust framework and has better predictive power than other technology acceptance models, explaining as much as 74% of intention variance (Venkatesh et al., 2012) which is a significant increase than can be explained by UTAUT (70%) and the eight previous models (17-53%) (Venkatesh et al., 2003). UTAUT2 has also been examined in various contexts and has become one of the influential frameworks for predicting technology acceptance (Aggarwal et al., 2019; Schukat et al., 2019; Septiani et al., 2021).

To gain a better understanding of the phenomenon of technology use, UTAUT2 as the main theoretical basis in this research can be extended with constructs that are relevant to the research context.

Previous researchers found that several variables have influenced the intention to use technology, including the perceived need variable (Li et al., 2020; Mukred et al., 2020), information publicity variable (Wang et al., 2019; Wang et al., 2014; Zhang et al., 2020), and product marketing variable (Migwi, 2016; Prasetya et al., 2021). Five independent variables of UTAUT2 will be involved in the proposed conceptual framework, namely performance expectancy, effort expectancy, social influence, facilitating condition, and price value. The original UTAUT2 variables that are not involved in the proposed conceptual framework are hedonic motivation and habit variables. In addition, it also does not involve the three moderating variables, namely gender, experience, and age. The hedonic motivation and habit variables are applicable in the context of acceptance and use of information technology but are not relevant to be applied in the context of the intention of rice farmers, who are not users of commercial biopesticide products, to use commercial biopesticide products.

### *The Conceptual Framework of Extended UTAUT2*



**Figure 3. Proposed Conceptual Framework for Analyzing the Intention to Use Commercial Biopesticide Products by Employing Extended UTAUT2**

Source: Data processed by author (2023)

This paper develops a conceptual framework regarding the behaviors of rice farmers who are not users of commercial biopesticide products, consisting of eight variables: (1) Performance expectancy, (2) Effort Expectancy, (3) Social influence, (4) Facilitating conditions, (5) Price Value, (6) Perceived need, (7) Information publicity, and (8) Product marketing. The conceptual framework of intention to use commercial biopesticide products by using extended UTAUT2 is as follows:

1. **Performance expectancy.** In this study, performance expectancy is defined as the extent to which farmers believe that using commercial biopesticide products will provide benefits. Previous studies by Venkatesh et al. (2003) and Venkatesh et al. (2012) found that the expected performance variable is the strongest predictor of intention. A similar conclusion was obtained from the results of the meta-analysis conducted by Khechine et al. (2016) of 197 studies that implemented UTAUT. Several empirical studies showed that there was a positive and significant influence between the expected

performance variables on intention (Aggarwal et al., 2019; Beza et al., 2018; Buettner, 2017; Faridi et al., 2020; Martín & Herrero, 2012; Schukat et al., 2019).

2. **Effort expectancy.** The operational definition of the effort expectancy variable in this study is the degree of ease of use of commercial biopesticide products. Empirical studies in various research contexts found a positive and significant effect between the expected effort variable on intention (Aggarwal et al., 2019; Beza et al., 2018; Faridi et al., 2020; Hayat et al., 2020; Martín & Herrero, 2012).
3. **Social influence.** In this study, the social influence variable is defined as the extent to which farmers perceive that other important people to them believe that farmers should use commercial biopesticide products. The positive and significant influence between the variables of social influence on intention was found in the results of the study by Aggarwal et al. (2019) and Schukat et al. (2019).
4. **Facilitating conditions.** In this study, the facilitating conditions variable is defined as the farmers' perceptions of the availability of resources and support for the application of commercial biopesticide products. Previous studies that hypothesized a relationship between the facilitating conditions variable and intention found that there was a positive and significant effect between these two variables (Buettner, 2017; Escobar-Rodríguez & Carvajal-Trujillo, 2013; Schukat et al., 2019).
5. **Price value.** The price value variable in the context of this study is defined as the farmers' perceptions of the perceived benefits of the application of commercial biopesticide products compared to the costs incurred for its application. According to Venkatesh et al. (2012) that the price value has a positive effect when the perceived benefits of using technology are considered to be greater than the costs incurred. Several previous studies found a positive and significant effect of the price value variable on intention, such as the intention to use rooftop solar (Aggarwal et al., 2019) and the intention to adopt a sharing economy peer-to-peer lending agricultural financing (Septiani et al., 2021).

The above review confirmed five variables from the UTAUT2 are suitable to explain the farmers' behaviors but are insufficient to describe the phenomena of farmers' intention to use commercial biopesticide products. We suggest more variables which will be able to strengthen the predictive power of the model. These include the variables of perceived need, information publicity, and product marketing, and can be explained as follows:

1. **Perceived need.** Rogers (2003) states that “the degree to which an innovation meets a need felt by potential adopters affects its adoption positively”. According to Wu et al. (2015), the perceived need for technology is often mentioned as a reason for someone to adopt it, and conversely, the lack of need for technology can be a reason that hinders the use of technology. To understand the decision-making process by farmers on the use of commercial biopesticide products, it is necessary to study whether the use of biopesticide technology is in accordance with the needs of farmers. The perceived need variable has been used in several previous studies in various contexts that affect intention or behavior, including research on intention to use precision agricultural technology (Li et al., 2020) and hospital information systems (Mukred et al., 2020).
2. **Information publicity.** According to Rogers (2003), the innovation-decision process is essentially an information-seeking and information-processing activity in which an individual is motivated to reduce uncertainty about the advantages and disadvantages of innovation. The exposure of potential users to various sources of information has been almost ignored in previous studies on technology acceptance, but this variable has proven to be a key factor in the adoption of innovations in agriculture because it can reduce uncertainty about innovations and provide the skills required by users (Caffaro et al., 2020). In this concept, the information publicity variable is defined as all forms of efforts made to disseminate information about the advantages of commercial biopesticide products so as to increase knowledge and influence farmers to use commercial biopesticide products. Researches by Wang et al. (2014), Wang et al. (2018), Wang et al. (2019), and Zhang et al. (2020)

involved information publicity variable that can influence individual attitudes and behavioral intention.

3. **Product marketing.** One of the main assumptions in the theory of Diffusion of Innovation is that the first driving factor for farmers to adopt technology is to maximize profits (Adnan et al., 2019). This is supported by the statement of Parvan (2011) that farmers not only need access to production inputs but also access to marketing so that farmers can get an increase in income. Thus, farmers' intention in applying technology are also influenced by product marketing factor. Market demand, ease of marketing, and attractive selling prices will motivate farmers to apply the technology. Labaran (2015) informs that the consumer demand variable has a positive and significant effect on biopesticide adoption in Ghana. While, a study by Prasetya et al. (2021) found that the level of resistance of farmers to the application of organic rice was positively and significantly influenced by the uncertainty of selling prices and marketing.

Furthermore, the proposed conceptual framework is expected to give a comprehensive understanding of the non-users rice farmers' intention to use commercial biopesticide products by implementing extended UTAUT2 (Figure 3).

### **Hypotheses**

This study will test 8 hypotheses that were derived from the proposed conceptual framework as follows:

- H1: Performance expectancy significantly affects farmer's intention to use commercial biopesticide products
- H2: Effort expectancy significantly affects farmer's intention to use commercial biopesticide products
- H3: Social influence significantly affects farmer's intention to use commercial biopesticide products
- H4: Facilitating conditions significantly affects farmer's intention to use commercial biopesticide products
- H5: Price value significantly affects farmer's intention to use commercial biopesticide products
- H6: Perceived need significantly affects farmer's intention to use commercial biopesticide products
- H7: Information publicity significantly affects farmer's intention to use commercial biopesticide products
- H8: Product marketing significantly affects farmer's intention to use commercial biopesticide products

### **RESEARCH METHODS**

This research employs a quantitative method. Quantitative method not only allows to describe phenomena numerically, but it also helps determine the relationship between two or more variables (Neuman, 2014). Respondents in this study are rice farmers who are not users of commercial biopesticide products but they have already known information about commercial biopesticide products. Due to specified respondent criteria, this study employs purposive sampling technique. The number of respondents meets the general rule that the number of samples is at least 5 (five) times the number of coefficients. The data collection method in this study uses survey method. Primary data collection can be conducted with the help of a structured questionnaire instrument. The method used to analyze the data is structural equation modeling (SEM). According to Hair et al. (2014), SEM is part of a statistical model that seeks to explain the relationship between several variables, by testing the structure of the reciprocal relationship expressed in a series of equations that is similar to multiple regression equations. This equation describes all the relationships among the constructs (dependent and independent variables) involved in the analysis. Construct is an unobservable (latent) factor that is represented by several indicator variables. An indicator variable is a trait that is directly related to the latent variable, and can be observed or measured directly, and the minimum number of indicator variables is at least 2 variables. The accuracy of the selection of indicator variables will determine the level of construct reliability, the more complete the indicator variables, the better understanding of the latent variables. Recommendations in creation of questionnaire for the proposed concept is presented in Table 1. A five-point Likert scale is employed to measure the respondents' perceptions of the factors that influenced farmers' intention to use commercial biopesticide products. The scale is as follows: 1) Strongly Disagree, 2) Disagree, 3) Neutral,

4) Agree, and 5) Strongly Agree.

**Table 1. The Questionnaires Used to Collect Data**

<b>Latent variables and recommendations in creation of questionnaire</b>	<b>References</b>
<b>Performance expectancy (PE):</b> PE1 - The use of commercial biopesticide products will be able to control pests effectively. PE2 - The use of commercial biopesticide products will prevent the occurrence of target pest resistance. PE3 - The use of commercial biopesticide products will prevent the decline in natural predators population. PE4 - The use of commercial biopesticide products will prevent environmental pollution. PE5 - The use of commercial biopesticide products will be safer for fish. PE6 - The use of commercial biopesticide products will be safer for the health of farmers. PE7 - The use of commercial biopesticide products will produce better rice quality. PE8 - The use of commercial biopesticide products will produce residue-free rice that is safer for consumption.	(Akyüz & Theuvsen, 2020; Ataei et al., 2021; Rezaei et al., 2020; Sharifzadeh et al., 2017; Venkatesh et al., 2012)
<b>Effort expectancy (EE):</b> EE1 - I find it easy to learn how to use commercial biopesticide products. EE2 - How to use commercial biopesticide products is clear and easy to understand. EE3 – In my opinion, commercial biopesticide products are easy to use. EE4 – In my opinion, to become skilled in using commercial biopesticide products is easy.	(Faridi et al., 2020; Venkatesh et al., 2012)
<b>Social influence (SI):</b> SI1 - My family supports me to use commercial biopesticide products on my farm. SI2 - My fellow farmers support me to use commercial biopesticide products on my farm. SI3 - The head of the farmer group supports me to use commercial biopesticide products on my farm. SI4 - The agricultural extension workers encourage me to use commercial biopesticide products on my farm. SI5 - Marketing executives of a biopesticide company encourage me to use commercial biopesticide products on my farm. SI6 - The agriculture kiosks encourage me to use commercial biopesticide products on my farm.	(Rasyidha et al., 2020; Schukat et al., 2019; Venkatesh et al., 2012)
<b>Facilitating condition (FC):</b> FC1 - I have the necessary costs for the application of a commercial biopesticide product. FC2 - I have the necessary manpower for the application of a commercial biopesticide product. FC3 - I have the necessary information support for the application of a commercial biopesticide product. FC4 - It's easy for me to consult about biopesticides with agricultural extension officers. FC5 - It is easy for me to consult about biopesticides with private extension officers from biopesticide companies. FC6 - I can take training on biopesticides. FC7 - I can easily obtain commercial biopesticide products through farmer's kiosks. FC8 - I can easily obtain commercial biopesticide products through online stores.	(Faridi et al., 2020; Sharifzadeh et al., 2017; Venkatesh et al., 2012)
<b>Price value (PV):</b>	(Venkatesh et al., 2012)

Latent variables and recommendations in creation of questionnaire	References
PV1 - The price of commercial biopesticide products is affordable. PV2 - The benefits of using commercial biopesticide products outweigh the costs.	
Information publicity (PUB): PUB1 - Socialization about the use of commercial biopesticide products is often carried out. PUB2 - Information on commercial biopesticide products is easy to obtain. PUB3 - I often seek information on the use of commercial biopesticide products. PUB4 - I am involved in a demonstration plot of commercial biopesticide products. PUB5 - I can easily get information about commercial biopesticide products from the internet. PUB6 - I can easily obtain information about commercial biopesticide products from fellow farmers. PUB7 - The more information I get about commercial biopesticide products, the more my attention to the importance of biopesticides increases.	(Wang et al., 2019; Wang et al., 2014)
Perceived needs (PN): PN1 - I am not satisfied with the use of synthetic pesticides. PN2 - The use of commercial biopesticide products can meet my needs. PN3 - I am interested to use a commercial biopesticide product. PN4 - I need a more environmentally friendly commercial biopesticide product. PN5 - I need a commercial biopesticides product to produce residue-free rice products. PN6 - The promotion of biopesticides made me feel the need to use commercial biopesticide products. PN7 - Extension activities about biopesticides made me feel the need to use commercial biopesticide products. PN8 - Information from fellow farmers about biopesticides made me feel the need to use commercial biopesticide products.	(Jeong et al., 2009; Kang & Moneyham, 2010; Lin et al., 2015)
Product marketing (MKT): MKT1 - I am aware of consumer demand for residue-free rice. MKT2 - It will be easy for me to sell my products to farmer groups that already have a specific market for residue-free rice. MKT3 - It will be easy for me to sell my products to cooperatives that already have a specific market for residue-free rice. MKT4 - I will receive a higher price by selling a residue-free product. MKT5 - It will be easy for me to sell my product to traders/middlemen with the purchase price of residue-free rice similar to the market price of ordinary rice (-).	(Alexopoulos et al., 2010; Kusumo et al., 2018; Silaban, 2019)
Intention (INT) : INT1 - I will find out where to buy commercial biopesticide products. INT2 - I will save money to purchase commercial biopesticide products. INT3 - I am planning to use a commercial biopesticide product over the next growing season. INT4 - I am planning to purchase a commercial biopesticide product over the next growing season.	(Abadi, 2018; Rezaei et al., 2019; Venkatesh et al., 2012)

Source: Data processed by author (2023)

## CONCLUSIONS AND SUGGESTION

The limited research on the intention to use commercial biopesticide products using the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) among rice farmers who are not users of commercial biopesticide products has provided the impetus for this study to address this gap and contribute to existing literature. The conceptual framework proposes the application of extended UTAUT2 by studying relevant variables that are expected to affect the intention to use commercial biopesticide products. The extended UTAUT2 model conceptualizes that non-users farmers' intention to use commercial biopesticide products is expected to be influenced by performance expectancy, effort expectancy, social influence, facilitating condition, price value, perceived need, information publicity, and product marketing.

This study recommends that future research may apply this proposed conceptual framework and examines non-users farmers' intention to use commercial biopesticides products. The research results will be beneficial for policymakers and managers to explore and develop strategies to enhance farmers' intention to use biopesticides. The influential variables with the highest significance should first be applied as a priority to create policies and marketing strategies that can promote the use of commercial biopesticide products. In the long run, the use of biopesticide will also be expected to contribute to the creation of a balanced ecosystem and a sustainable environment.

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