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Factors Affecting Farmers' Intention to Produce Rice Straw Mushrooms Indoors: A Case Study in Tan Hung District, Long an Province, Vietnam

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Abstract: This article examines the factors influencing farmers' intentions to produce indoor rice straw mushroom production in Tan Hung district, Long An province, Vietnam, thereby propose the solutions to support farmers to develop this model more effectively. Data was collected through interviews with 120 farmers, comprising 23 indoor and 97 outdoor growers. Using descriptive statistics, Cronbach's Alpha test, exploratory factor analysis, and multivariate linear regression, the study identifies five significant factors affecting farmers' intentions: Perceived Usefulness, Perceived Ease of Use, Subjective Norms, Perceived Behavioral control and Resources of farmers. The findings indicate that indoor mushroom growing model brings higher profits for farmers as compared to the outdoor model. Based on these findings, the study proposes several solutions to improve indoor rice straw mushroom production and increase economic value for farmers in Tan Hung district.

Keywords: mushroom, rice straw, factor, intention, Tan Hung, Long An, Viet Nam, indoor, outdoor, Volvariella volvaceae.

1. Introduction

Rice straw mushroom (Volvariella spp.) is a diverse fungus with nearly 100 species, the most widely cultivated fungus is called *Volvariella volvaceae*, found on rotten straw (Ho Thi Thu Ba *et al.*, 2024). The study of Chang (1969) assumes that this kind of mushroom grows on decaying plants and takes nutrients from them, mainly concentrated in subtropical and tropical regions. Rice straw mushrooms have been around for quite a long time in Asia, but the first cultivation and harvesting occurred in China 200 years ago. Nowadays, countries have grown mushrooms on a larger and more popular scale such as Vietnam, Thailand, Japan, Korea. Rice straw mushroom products sold on the market are mainly fresh mushrooms (accounting for 45%), canned mushrooms (about 50%), the remaining 5% are in dried form or more complicated as functional foods (Nguyen Huu Dong *et al*, 2000). The consumption of rice straw mushrooms has recently increased because in addition to their flavor, they also have high nutritional content (Bernas *et al*, 2006). Rice straw mushroom is one of the nutritious foods, which is high in minerals, contains lots of vitamins and essential amino acids that the body can not synthesize (Verma *et al*. 2013). In particular, rice straw mushrooms are a source of polypeptides, terpenses, steroids and in the extracted water they have antioxidant properties, helping to prevent cardiovascular diseases or cancer (Cheung *et al*.,2003).

In Vietnam, the research on mushrooms from breeding technology, cultivation and processing have begun around 1963 (Viet Chuong, 2011). The country has many advantages for mushroom production with diverse material sources, low-cost labor, favorable weather, high consumption demand (Pham Thi Gam Nhung *et al*, 2021). In previous stages, farmers in the southern region mainly applied outdoor mushrooms growing methods (Le Duy Thang, 2006). Growing mushrooms outdoors is an effective solution to deal with the amount of waste and by–products in agricultural, industrial or forestry production such as rice straw, sawdust, cotton wastem, bagasse. (Nguyen Huu Dong *et al*, 2005). The Mekong Delta, which is considered as the greatest granary of the country, produces a huge amount of straw after each harvest season. Farmers' habit of burning rice straw before planting another crop not only wastes of valuable resource but also leads to air pollution, causing greenhouse effect and negatively affects agricultural production and community health (Tran Sy Nam *et al*, 2014). To solve this problem, growing straw mushrooms is considered as an optimal solution that can help effectively utilize the abundant straw resources in the Mekong Delta (Le Vinh Thuc and Ngo Thi Thanh Truc, 2013).

In Tan Hung district, Long An province, most of farmers still maintain the habit of burning straw right in the fields, leading to soil degradation, ecological imbalance and air pollution, negatively affecting the lives of the community (Van Sach, 2024). In this context, developing the mushroom production industry, both outdoors and indoors, is a solution to take advantage of the region's abundance of rice straw. Not only does this create jobs for local people, it also helps increase income and improve the quality of life for the residents. However, the efficiency of farmers' producing rice straw mushrooms still has disadvantages and they have to face lots of difficulties. Although outdoor growing straw mushroom model is popular, it is easy to be affected by weather and climate conditions. Meanwhile, some farmers started choosing indoor mushroom cultivation model with plenty of merits such as yearround production, easy application of science and technology to improve productivity and quality, bringing more stable economic efficiency. However, this model has not been widely applied in Long An province in general and Tan Hung district in particular. Therefore, it is necessary to analyze the factors affecting the intention to produce straw mushrooms indoors to propose solutions to support farmers to develop this model more effectively.

2. Theoretical Background and Methodology

2.1. Theoretical Framework

Choice Theory

Choice Theory can be approached from different perspectives. According to economists, human selection behaviour is generally influenced by "money motive" (Crossman, 2010). It means that people are always interested in opportunities to increase profits, consider comparing the expenses and the benefits before each selection. Otherwise, sociologists such as Friedman and Hechter (1988) argued that individuals are intentional and purposeful when making decisions, they always consider to gain the highest benefit. Meanwhile, psychologists assumed that people seem to have similar needs and each person has a lot of different ways to choose the things that satisfy those demands. These opinions together create a multidimensional view of how choice theory can be understood and applied.

Theory of Reasoned Action (TRA)

Theory of Reasoned Action (TRA) was proposed by Fishbein và Ajzen in 1975 and continued being improved in 1980, provides a solid theoretical framework to

explain the relationship between attitudes, behavior and human action decisions. TRA is often applied to predict individual behavior based on pre-formed attitudes and behavioral intentions (Haris *et al*, 2017). According to Fishbein và Ajzen (1975), behavioral intention is not only the result of individual thinking but also the product of the complex interaction between individual attitudes and social norms, thereby clearly demonstrating the influence of the social environment on each individual's action decisions. TRA was born out of great disappointment of traditional attitude – behavior studies, most of which pointed out a poor correlation between attitude measures and performance of intended behaviors. This theory focuses on 3 main concepts: Behavioral Intention - BI, Attitude – A and Subjective Norm - SN. In TRA, behavioral intention is decided by attitude and subjective norm, form the basis for predicting individual behavior.

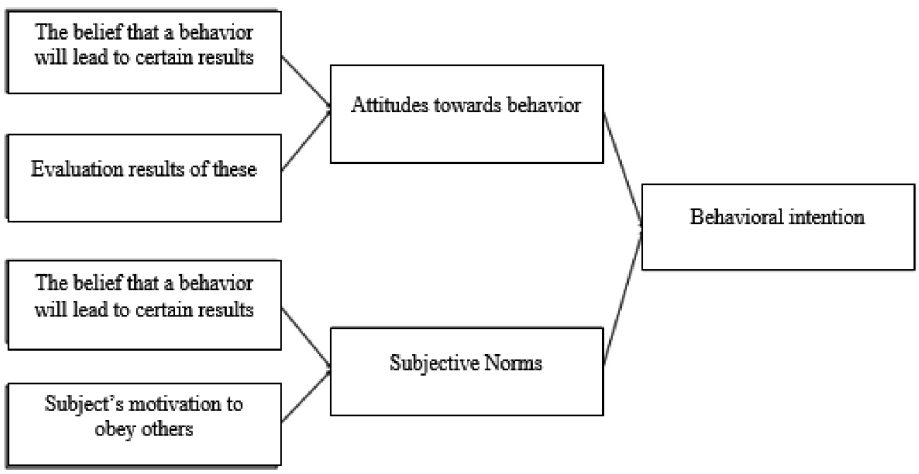

Figure 1: TRA model of Fishbein & Ajzen (1975) và Ajzen & Fishbein (1980)

Theory of Planned Behavior (TPB)

Theory of Planned Behavior - TPB is a model was developed based on theory of reasoned action of Fishbein và Ajzen (1980). Ajzen (1991) extended and completed TPB to explain how individual behavior could be controlled at will. This model was born early and applied widely, assumed that the higher the intention to perform a behavior, the stronger the likelihood of performing that behavior (Ajzen, 1991). TPB emphasizes that human behavior is the results of rational and intentional choices, rather than random or spontaneous actions. However, each individual's behavior is not only dependent on personal intentions but also influenced by external factors

such as opportunities, financial resources, and relationships (Senger *et al*., 2017). According to TPB, when people perform a behavior, their decisions are not only based on personal desires but also influenced by 3 main factors: attitude, subjective norms, and perceived behavioral control (Chen *et al*, 2016).

The analysis of factors affecting the intention to apply agricultural production models has been carried out by several authors. The two major analytical methods are Exploratory Factor Analysis – EFA (Sriwaranun *et al*, 2019; Rostiar *et al*, 2020; Kassa *et al*, 2022; Le Dang Lang and Le Tan Buu, 2014; Pham Trieu, 2014) and Logistic Regression Analysis (Laosutsan *et al*, 2019; Ongoche, 2017; Ahir *et al*, 2021; Ngo Thi Thanh Truc, 2013; Le Thi Hoa Sen *et al*; 2013). The main factors influencing the intention to select to apply production model are perceived usefulness, production resources, applicability, surrounding environment, subjective standards, technical support, economic efficiency, environmental merits, propaganda and awareness of controlling behaviors, and other control factors (such as age, gender, household size, income, location, and land area).

2.2. Research Model

Based on Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), and the results of previous researches, the authors propose 5 factors affecting the intention to produce straw mushroom indoors as follows:

Perceived Usefulness

TAM model with its perceived usefulness component has been extensively studied in the implementation of new technologies. Perceived usefulness is defined as when people apply a specialized system, it will help improve work efficiency (Davis *et al*, 1989). Studies by Nguyen Thi Ngoc Anh (2016), Nguyen Hong Quan *et al* (2023), Pham Nguyen Minh Tri (2021) all found that perceived usefulness has an impact on the intention to use and produce a new technology. Perceived Usefulness (U) has a positive influence on the intention to produce straw mushroom indoors, including the observed variables: *I think a large number of products will be created by planting straw mushroom indoors (U1); I think products will be of better quality through this model (U2); I think this model will increase the product competitiveness (U3); I think it can help farmers to be more active in production, and be less dependent on the weather and climate (U4). I think it contributes to environmental protection (U5)*. (Sriwaranun *et al*, 2019; Rostiar *et al*, 2020; Kassa *et al*, 2022; Le Dang Lang và Le Tan Buu 2014; Pham Trieu, 2014)

H1: Perceived usefulness is appreciated that will promote intention to produce straw mushrooms indoors.

Perceived Ease of Use

Perceived Ease of Use is an extremely important factor in TAM. This concept refers to the extent to which an individual believes that using a particular system will not require significant effort on their part (Nguyen Dinh Yen Oanh *et al*, 2019). The easier a system is to use, the less effort users feel they have to put into learning how to operate and exploit it effectively. This thing not only makes users feel more comfortable approaching new things but also increases the likelihood that they will adopt and use that technology regularly. Davis *et al* (1989) emphasized that in the context of a technology system that is highly rated for ease of use, users will tend to face fewer psychological and practical barriers, thereby increasing their acceptance and adoption of the system. In our country, there is a lot of potential for growing and producing straw mushrooms because there are abundant raw materials, abundant labor resources and simple mushroom production methods (Pham Thi Gam Nhung *et al*, 2021). Perceived Ease of Use (EU) has a positive influence on the intention to produce straw mushroom indoors, including the observed variables: *Easy to learn how to use (EU1); I will be proficient quickly (EU2); It is convenient and easy to carry out (EU3); Giving me freedom to do other things (EU4)*

H2: The higher the perceived ease of use, the greater the intention to produce straw mushrooms indoors.

Subjective Norms

Subjective norms, also known as social influence, is an important factor in understanding human behavior (Phan Anh Tu *et al*, 2015). It represents an individual's perception of pressure from the surrounding social environment to act in a certain way or to refrain from performing a certain behavior. For Ajzen và Fishbein (1975), subjective norm is a factor that decides if people will conform to social norms or not, since they can feel the expectations and pressure from people around them. Subjective norms play an important role in shaping the production intentions of firms or individuals. In particular, subjective norms related to production intentions reflect the perception of decision makers of pressures and expectations from the surrounding social environment, such as business partners, suppliers, customers, and even industry norms or legal regulations. When a business

or individual perceives that important stakeholders in their network expect or pressure them to produce a certain product or service, this may motivate them to lean toward the decision to produce that item, even if they may not fully trust in the feasibility or profitability of this decision. Subjective norms (S) have a positive influence on the intention to produce straw mushroom indoors, including the observed variables: *I'm influenced by lots of farmers around who grow straw mushroom indoors (S1); State agencies have investment policies to support indoor straw mushroom production and that affects my choice (S2); My selection is affected by my family's advices (S3); My selection is affected by my friends' advices (S4); I'm affected by media (S5)*

H3: Subjective norms will affect positively the intention to produce straw mushroom indoors.

Perceived Behavioral Control

Perceived Behavioral Control plays an important role in shaping production intentions of businesses or individuals. Perceived Behavioral Control reflects the extent to which decision maker believes he or she has the ability to perform a particular behavior, in this case the production of a product or service. This factor concludes perception of available resources such as finance, technology, human resources, and infrastructure, and potential barriers that may hinder the production process. When a business or an individual thinks that they have the capacity, knowledge, and conditions to implement a production process, the intention to perform the production behavior will be stronger. Perceived Behavioral Control (B) has a positive influence on the intention to produce straw mushroom indoors, including the observed variables: *For me, growing straw mushroom indoors is very easy (B1); Planting straw mushroom indoors is completely decided by me (B2); Cultivating straw mushroom indoors is inevitable trend (B3)*

H4: The higher perceived behavioral control, the greater the intention to produce straw mushroom indoors.

Production Resources of farmers

Production Resources of farmers (PR) is a key factor, affecting directly and positively the intention to plant straw mushroom indoors. When farmers have a strong enough workforce, they can not only carry out production activities effectively but also ensure both the quantity and quality of mushrooms, as well as maintain continuous production. The high level of education of farmers helps them easily

access and apply new techniques, thereby improving production efficiency and creating a competitive advantage in the market. At the same time, investment capital plays an important role not only in purchasing raw materials and tools but also in maintaining production activities throughout the crop. Factors such as *Labor resources (PR1); Level of education (PR2); Cultivated area (PR3); Production capital (PR4)* are all closely related and positively affect the intention to produce straw mushrooms at home, according to studies by Sriwaranun *et al*, (2019), Rostiar *et al* (2020), Kassa *et al* (2022), along with Le Dang Lang and Le Tan Buu (2014).

H5: The more attention is paid to the production resources of farmers, the more the intention to produce straw mushrooms indoors is increased.

Dependent variable intention to produce straw mushroom indoors (I) includes the observed variables: *I will produce straw mushroom indoors (I1); I intend to expand the scale of straw mushroom production indoors (I2); When there are suitable conditions, I will plant straw mushroom indoors (I3)* (Le Dang Lang and Le Tan Buu, 2014; Pham Trieu, 2014, proposed by authors).

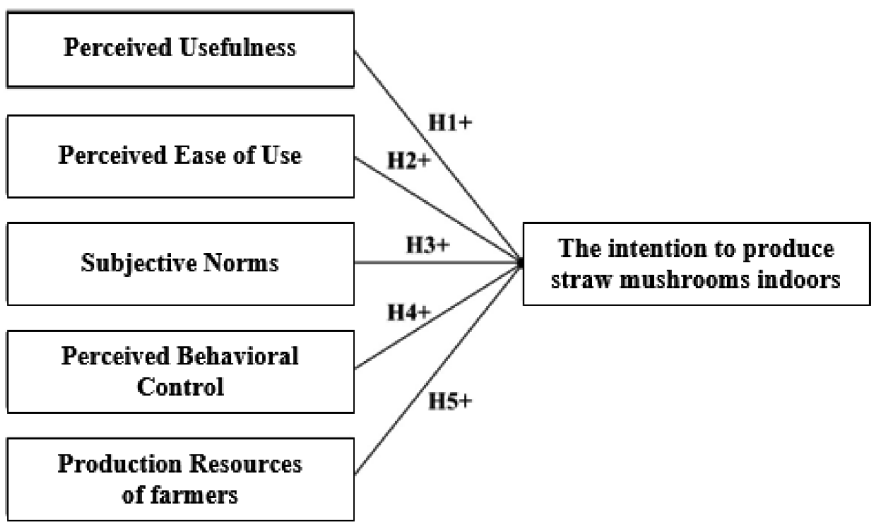

Figure 2: Proposed research model

2.3. Methodology

Sample size

According to Gorsuch (1983), Hair *et al* (2009), Exploratory Factor Analysis (EFA) has a sample size of at least 5 samples per observed variable. With 24 observed

variables for 5 independent variable and 1 dependent variable, the minimum number of farming households that to be surveyed is n = 5*24 = 120 households. Using simple and random sample selection methods, the authors investigated 23 households growing rice straw mushroom indoors and 97 households growing rice straw mushroom outdoors.

Data analysis

This research uses Descriptive Statistics, Cronbach's Alpha, Exploratory Factor Analysis EFA and Multiple linear regression to analyse factors affecting the intention to produce straw mushroom indoors of farmers.

3. Results and Discussion

3.1. Straw Mushroom Production's Efficiency

Table 1: Straw mushroom production's efficiency in 1 m^2/crop

Unit: Thousand VND

No	*Target*	*Straw mushroom production outdoors (1)*	*Straw mushroom production indoors (2)*	*Difference (2) - (1)*
1	Productivity (kg/m^2)	1,28	1,41	0,13
2	Price of 1kg of fresh mushroom	41,00	43,50	2,50
3	Revenue	52,48	61,34	8,85
4	Production cost	33,71	35,20	1,49
5	Profit	18,77	26,14	7,36

Source: Calculated from survey results, 2024

The calculation results in Table 1 show that the indoor straw mushroom growing model is more effective than the outdoor model. Specifically, the mushroom yield is 0.13kg/m^2 higher, the selling price increased by 2.50 thousand VND/kg, and the revenue is also significantly higher at 8.85 thousand VND/m^2. Although the indoor production cost is 1.49 thousand VND/m^2 higher, the final profit is still superior with a difference of 7.36 thousand VND/m^2. These figures not only emphasize the superiority of the indoor model but also confirm the need to encourage the expansion of this model to optimize income for farmers.

3.2. Assess the reliability of the scale using Cronbach's Alpha

Table 2: Results of Cronbach-alpha reliability coefficient analysis of independent variables

Scale	*Observed variable*	*Total variable correlation*	*Cronbach-alpha if variable is excluded*	*Cronbach-alpha*
Independent variable				
Perceived Usefulness (U)	U1	0,847	0,790	0,864
	U2	0,498	0,875	
	U3	0,513	0,889	
	U4	0,861	0,788	
	U5	0,773	0,815	
Perceived Ease of Use (EU)	EU1	0,894	0,864	0,818
	EU2	0,647	0,949	
	EU3	0,831	0,888	
	EU4	0,891	0,866	
Subjective Standard (S)	S1	0,743	0,799	0,844
	S2	0,393	0,910	
	S3	0,767	0,782	
	S4	0,781	0,777	
	S5	0,741	0,791	
Perceived behavioral control (B)	B1	0,789	0,778	0,869
	B2	0,743	0,822	
	B3	0,723	0,841	
Production Resources (PR)	PR1	0,836	0,786	0,868
	PR2	0,654	0,859	
	PR3	0,686	0,845	
	PR4	0,714	0,835	
Dependent Variable				
Intention (I)	I1	0,329	0,721	0,634
	I2	0,444	0,540	
	I3	0,591	0,335	

Source: Results of analysis SPSS, 2024

The consequence of Table 2 assesses the reliability of 5 independent variables with 21 observed variables and 1 dependent variable with 3 observed variables with Cronbach's Alpha coefficient greater than 0,6 and total correlation coefficient greater than 0,3, so all observed variables are eligible for exploratory factor analysis.

3.3. Exploratory Factor Analysis (EFA)

Table 3 shows that the KMO coefficient in the analysis is 0,734>0,5, indicating that the results of factor analysis are reliable. Bartlett's Test has Sig coefficient is 0,000 < 0,05, illustrating that factor analysis results ensure statistical significance. The average variance extracted is 73,777>50%, showing that the variation of the analyzed factors can explain 73,777% of the variation of initial survey data, this is a fairly significant level.

Table 3: Exploratory Factor Analysis – EFA results

Factors	*Eigenvalues*	*Average variance extracted (%)*	*KMO coefficient*	*Sig, (Bartlett's Test)*
1	4,045	19,264	0,734	0,000
2	3,967	38,153		
3	3,198	53,384		
4	2,511	65,339		
5	1,772	73,777		

Cre: Results of analysis SPSS, 2024

The results of the rotated factor matrix (Table 4) extracted 5 factors with 21 observed variables with factor loading coefficients greater than 0.5. Therefore, after conducting exploratory factor analysis EFA, all of observed variables which were retained are 21 variables to group into 5 independent variables.

Table 4: Rotated factor matrix

Observed variables	*Factors*				
	1	*2*	*3*	*4*	*5*
U4	0,937				
U1	0,921				
U5	0,883				
U2	0,639				
U3	0,626				
S4		0,896			
S5		0,877			
S3		0,843			
S1		0,806			
S2		0,578			
EU4			0,945		

Observed variables	*Factors*				
	1	*2*	*3*	*4*	*5*
EU1			0,937		
EU3			0,917		
EU2			0,774		
PR1				0,913	
PR4				0,858	
PR2				0,796	
PR3				0,777	
B1					0,895
B2					0,864
B3					0,851

Source: Results of analysis SPSS, 2024

3.5. Linear Regression Analysis

From the above factor analysis results, calculate the average of the independent and dependent variables to use in OLS Linear Regression Analysis. The results are shown in Table 5:

Table 5: Linear regression analysis results of model

Model	*Unstandardized regression coefficients*		*Standardized regression coefficients*	*Test value* τ	*Sig.*	*Variance Inflation Factor (VIF)*
	β	*Standard deviation*	β			
Constant	1,597	0,274		5,818	0,000	
U	0,110	0,027	0,301	4,072	0,011	1,062
EU	0,124	0,029	0,314	4,323	0,032	1,020
S	0,115	0,033	0,258	3,456	0,001	1,083
B	0,087	0,029	0,226	2,978	0,004	1,121
PR	0,164	0,047	0,260	3,470	0,026	1,091
R		0,772	Durbin Watson		1,986	
R^2		0,712	Sig. F		0,000	
R^2 correction		0,687				

Source: Analysis result SPSS, 2024

The F statistic of this regression model has Sig = 0,000 (<0,05) showing the model fits the data set. R^2 = 0,712 indicates that the model explains 71,2% of the independent variables with dependent variables. Variance Inflation factor VIF of variables in the model are all very small (1.020 to 1.121), proving that the regression model does not violate the multicollinearity hypothesis.

Independent variables all have Sig less than 0.05 and are positive, so the above variables all have a positive effect on the intention to grow straw mushroom indoors of farmers in Tan Hung district, Long An province. The impact level of factors affecting the intention to cultivate straw mushroom indoors of farmers in Tan Hung district is arranged in decreasing order as follows: Perceived ease of use (β = 0,314), Perceived usefulness (β = 0,031); Production resource of farmers (β = 0,260); Subjective standard (β = 0,258); Perceived behavioral control (β = 0,226).

3.6. Recommendations

In order to increase farmers' ability to participate in indoor straw mushroom production, some recommendations are proposed as follows:

Local agricultural extension agencies will develop standardized straw mushroom cultivation procedures tailored to local conditions through thorough surveys. They will compile instructional manuals and collaborate with the Tan Hung District People's Committee and relevant departments to organize farmer training sessions, equipping them with the necessary techniques for effective indoor mushroom production.

The government needs to invest in policies that view straw mushroom cultivation as a complementary industry to rice farming, adding value to the entire rice production value chain. Simultaneously, promote the environmental benefits of rice straw recycling, fostering a sustainable circular economy.

The extension services need to focus on researching to select and isolate the varieties of straw mushroom spawns which are suitable for each production area, ensuring good adaptation to the specific agricultural ecosystem in Tan Hung district. This will help increase the quality of mushrooms and optimize the output, thereby increasing the profits for farmers.

The local government also need to focus on credit policies, coordinate with credit funds and local banks to implement small credit packages for farmers. In addition, there should be policies to encourage the establishment of cooperatives and cooperative groups to form concentrated farming areas, and organize product consumption associated with businesses and distributors. Moreover, develop production standards and plan concentrated straw mushroom growing areas to have a key investment plan for straw mushroom production.

4. Conclusion

Indoor rice straw mushroom growing model is superior to outdoor model thanks to outstanding advantages such as reducing rice straw and watering costs, easy harvesting, high productivity, beautiful appearance, leading to higher selling price and profit. Therefore, expanding the indoor straw mushroom growing model is an inevitable step. The research shows that there are 5 factors affecting the intention to produce straw mushroom indoors of farmers in Tan Hung district, Long An province that are arranged in descending order as follows: Perceived Ease of Use (EU); Perceived Usefulness (U); Production Resources of farmers (PR); Subjective Standards (S); Perceived Behavioral control (B). From this result, the study proposes a number of solutions to increase the ability to expand the indoor straw mushroom production model and facilitate farmers in Tan Hung district. However, the study is still limited by the small sample size or lack of representation of all farmers in the region, reducing the accuracy and generalizability of the results. In addition, the proposed measures may face difficulties in implementation due to limited resources and support from authorities.

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