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Research Article

Farmers' intention to apply agricultural e-commerce: Extending the Technology Acceptance Model (TAM) with perceived enjoyment and perceived e-commerce self-efficacy

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ABSTRACT- E-commerce can play an increasingly strong role in boosting agricultural development. This study aimed to understand citrus growers' behavioral intention to apply agricultural e-commerce. The research used a cross-sectional survey of Jahrom citrus growers in Iran. So, 360 citrus growers were selected to participate in this study, and data were collected with a structured questionnaire. All the hypotheses relating to the Technology Acceptance Model (TAM) components, and those relating to the extended TAM were supported. Attitude, perceived e-commerce self-efficacy, perceived usefulness, perceived enjoyment, and perceived ease of use were the most important variables influencing citrus growers' behavioral intention. Improving farmers' agricultural e-commerce attitudes and skills through training programs and establishing stability in the market seems to be a useful strategy to develop their intention to use agricultural e-commerce.

INTRODUCTION

E-commerce means buying or selling goods or services through the internet (Henderson et al., 2004; Huo & Mu, 2017; Ahmadi & Ghorbanpour, 2021). Three major categories of agricultural e-markets can be identified: 1- e-markets for agricultural products, operated by farmers or retailers, where they sell agricultural products to consumers, 2- e-markets run by agricultural companies, where they sell production factors and agricultural inputs to farmers, and 3- e-markets for services by third parties, where specialist support services are provided to farmers (Wilson, 2000; Dong & Tarofder, 2024; Azhar et al., 2024). Since the number of internet users has increased, many businesses have turned to e-commerce (McFarlane et al., 2003; Lin, 2019). Meanwhile, expanding Information Communications Technology (ICT), especially in rural areas (Jamaluddin, 2013), has significantly fueled the improvement of agricultural e-commerce (Wang et al., 2016; Putri et al., 2023).

Generally, agricultural e-commerce can provide many advantages to users and stakeholders. Examples of benefits include increased profitability, the elimination of intermediaries, greater market development for agricultural production, increasing awareness of market prices, more access to national and international markets, the promotion of agricultural products, increased competition among suppliers of agricultural inputs, improved quality of agricultural products, increased revenues of farmers, and the acceleration of agricultural and rural economic structures (Liu et al., 2013; Asadihkoob & Ebrahimi, 2014). As a result, e-commerce can play a significant role in strengthening agricultural development (Cai et al., 2015). In Iran, agriculture is an important economic sector that accounts for a high percentage of production and employment and plays an impressive role in economic development. In Iran's Sixth Economic and Socio-Cultural Development Program, the growth rate of the agricultural sector is estimated to be 8%. One way to achieve this goal is to focus on crop markets. According to Omidi Najafabadi (2010), traditional crop markets in Iran do not meet today's needs, and agricultural markets have suffered from some issues. The emergence of agricultural e-commerce in Iran could eliminate many challenges of production and marketing in the agricultural sector. Therefore, the main theme of this research was understanding citrus growers' intention towards applying agricultural e-commerce.

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Meanwhile, the user's acceptance is the first step of any business, which is the main component of the further spread of new technology. According to Uzoka et al. (2007), apart from infrastructural factors, behavioral factors can also influence e-commerce acceptance. Although ICT acceptance has extensively been examined in the world, few studies have addressed agricultural e-commerce acceptance. The Technology Acceptance Model (TAM) is the most dominant theory to describe people's acceptance of information systems (Gefen & Straub, 2000; Syafei & Yulianto, 2024). Previously, the TAM and its extensive formats have been applied to the adoption of information systems or particular technologies (Biucky & Harandi, 2017; Hailemariam et al., 2024; Sönmez et al., 2024; Salimon et al., 2020). Davis (1989) used the TAM to show that the intention to apply an innovation is determined by attitude and perceived usefulness. The TAM consists of two components: perceived usefulness (PU) and perceived ease of use (PEU).

Therefore, we have extended the TAM in this research. In our model, after reviewing the e-commerce acceptance literature, we added "perceived enjoyment" and "perceived e-commerce self-efficacy" to improve the predictive power of the TAM. Our model used the TAM extension to study citrus growers' behavioral intentions of using agricultural e-commerce. Therefore, after reviewing the related studies in the field of technology acceptance, in line with Davis et al. (1992), perceived enjoyment was added to the TAM. Perceived enjoyment is a measure of intrinsic motivation that is included in the conceptual model. By doing this, both intrinsic and extrinsic utilities were considered in the conceptual model (Fig. 1). The concept of "perceived usefulness" has been widely used in technology acceptance studies. The importance of this variable for attitude and intention has been shown in many e-commerce studies (Ashraf, 2016; Basarir-Ozel & Mardikyan, 2017; Gan et al., 2018; Wilson, 2019; Sundjaja, 2020). Therefore, this research assumes the following hypotheses:

H1: PU has a significant impact on the attitude toward applying agricultural e-commerce.

H2: PU has a significant impact on the intention to apply agricultural e-commerce.

In the TAM, PEU is posited to have a significant influence on attitude. In the literature on e-commerce adoption and use, several studies have indicated the significant impact of the perceived ease of use on the users' attitude toward adopting e-commerce (Smith, 2008; Al Ziadat et al., 2013; Renny et al., 2013; Kanchanatanee et al., 2014). Thus, the following hypotheses are presented in this study:

H3: PEU has a positive and significant impact on the attitude toward applying agricultural e-commerce.

H4: PEU has a significant impact on the perceived usefulness of applying agricultural e-commerce.

Internal stimuli based on emotional appraisal have not been considered in the TAM. Thus, Davis et al. (1992) considered perceived enjoyment to be a form of internal motivation as opposed to perceived usefulness. The concept of "pleasure" in Mehrabian and Russell's (1974) theory is somewhat similar to the concept of "perceived enjoyment". Pleasure in this theory refers to a continuum ranging from extreme pain or unhappiness to extreme happiness. Pleasure in their theory is proposed to have a significant effect on the attitude toward behavior. Likewise, a similar factor to perceived enjoyment – perceived fun – was supported by Igbaria et al. (1994) as a factor predicting the use of technology. Several studies, including those of Yu et al. (2005), Suki and Suki (2011), Cheema et al. (2013), Alalwan et al. (2018), and Manis and Choi (2019), have considered perceived enjoyment and found that perceived enjoyment has significant effects on the behavioral intention. Yu et al. (2005), Praveena and Thomas (2014), and Manis and Choi (2019) also showed that perceived enjoyment as a variable added to the TAM can influence the attitude toward behavior. In conclusion, the following hypotheses are proposed in this research:

H5: Perceived enjoyment has a significant impact on attitude toward using agricultural e-commerce.

H6: Perceived enjoyment has a significant impact on the intention to use agricultural e-commerce

Generally, self-efficacy is defined as people's beliefs about their ability to influence events that affect their lives (Bandura, 1997). Self-efficacy can be changed and developed over time by experience or practice. Kim et al. (2009) showed two types of self-efficacy, including general self-efficacy and specific self-efficacy. In many studies, we can find different types of specific self-efficacy. McDonald and Siegall (1992) and Hsu and Chiu (2004) identified web-specific self-efficacy and general Internet self-efficacy. In the field of Information Technology (IT), Roca et al. (2006) identified computer self-efficacy and Internet self-efficacy. They considered these two types of self-efficacy as perceived behavioral control. In this study, we consider e-commerce self-efficacy as the adequate and accurate aptitude and skill set to succeed when dealing with e-commerce. According to Davis (1989), self-efficacy is similar to perceived ease of use. Venkatesh and Davis (1996) also believe that self-efficacy and ease of use might be closely linked. Thus, in many studies, perceived self-efficacy and perceived ease of use are related to each other (Khan et al., 2024; Pan et al., 2024; Wibowo et al., 2024; Singh & Srivastava, 2020).

So, two hypotheses are considered in this research:

H7: Perceived e-commerce self-efficacy has a significant impact on the perceived ease of applying agricultural e-commerce.

H8: Perceived e-commerce self-efficacy has a significant impact on the intention to apply agricultural e-commerce.

Fishbein and Ajzen (1975) define attitude as a person's feelings (evaluative affect) about performing the target behavior. The TAM proposes that attitude has a positive effect on behavioral intention. The effect of attitude on intention has also been supported in the e-commerce domain (Kim, 2012; Nguyen et al., 2019; Ha & Nguyen, 2019). Therefore, this study assumes the following hypothesis:

H9: Attitude has a significant effect on the intention to use agricultural e-commerce.

Behavioral intention has been considered an important indicator of the occurrence of a behavior (Venkatesh et al., 2003). Fishbein and Ajzen (1975) define behavioral intention as the amount of effort one is willing to put into attaining a goal. This concept has a strong impact on future behavior (Bamberg, 2003). In this study, we hypothesize that if farmers have a stronger behavioral intention to use agricultural e-commerce, they are more likely to use it.

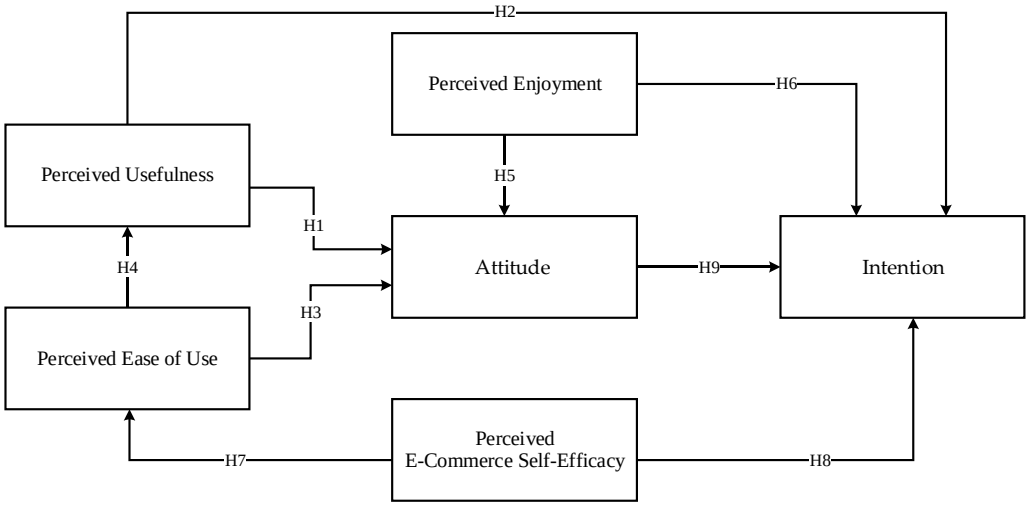

Fig. 1. The conceptual model of the research.

MATERIALS AND METHODS

This study employs descriptive and correlational research methods using data collected in a survey with structured questionnaire distribution.

The survey instrument was divided into two parts: the personal section and the constructs-related section. The first section focused on age, education, farming experience, monthly income, and garden size. $SPSS_{25}$ software was used for descriptive analysis of the respondents' personal information. In the second section, citrus growers were asked to express their opinions using a 1-5 Likert scale with endpoints of "strongly agree= 5", "agree= 4", "undecided= 3", "disagree= 2," and "strongly disagree= 1". Exactly, 3566 Jahrom citrus growers were defined as the study population, and 360 citrus growers selected by stratified random sampling participated in the research (Khafr = 48, Central = 43, Kordian = 77, and Simakan = 192). A panel of experts confirmed the face validity of the measurement items. Cronbach's alpha was also used to determine the reliability of the measurement scales. The analysis showed that all the items had factor loadings higher than 0.7 and were, accordingly, significant (Table 1). The results revealed that all CRs were above 0.70, showing acceptable levels of reliability. Average variances extracted (AVE) were all over 0.50, proving that the constructs had acceptable convergent validity (Table 2).

The structural model was tested using the $AMOS_{24}$ procedure, a software package designed to perform the structural equation model approach to path analysis. Path analysis is a variation of multiple-regression analysis and is useful to analyze a number of issues involved in causal analysis (Stage et al., 2004).

RESULTS AND DISCUSSION

In the samples, all citrus producers were male. Based on age, their average age was about 43 years and most of the respondents (42.8%) were 33-45 years. Based on the educational level, most of the respondents had under high school diploma education. Also, 30% of the citrus producers had diplomas or associate degrees and the rest (6.7%) had bachelor's degrees or higher (Table 3). According to farming experience, most (44.7%) had 13-22 years of experience. The average of their monthly income was 1.7 million IRR. Based on the garden size, most of them (60.8%) had under five hectares. Furthermore, the average size of gardens was 1.4 hectares.

Table 4 shows the mean score of the variables used in this study. The lowest mean score of 2.18 went to perceived e-commerce self-efficacy, showing that the respondents perceived that their efficacy in engaging in e-commerce was somewhat low. The highest mean score was related to perceived usefulness.

The findings reveal that the goodness of fit index (GFI) score was above 0.9, the threshold suggested by Fornell & Larcker (1981). The root mean square error of approximation (RMSEA) score was below 0.05, which is acceptable. The scores of normed fit index (NFI) and non-normed fit index (NNFI) were both greater than 0.9. The score of comparative fit index (CFI) of 0.99 was greater than 0.95. Therefore, the model, which is presented in Fig. 2, was fitted. According to Imam (2005), the path coefficient is significant at the 0.05 level when the critical ratio is more than 1.96. According to Table 5, overall, all nine hypotheses were supported by the data. All the hypotheses relating to the TAM variables (H1 to H4 and H9), as well as those relating to the extended TAM (H5-H8), were significant. The variables of farmers' attitude, perceived usefulness (PU), perceived ease of use (PEU), perceived enjoyment (PE), and perceived e-commerce self-efficacy (PES) predicted behavioral intention ($R^2 = 0.527$). This means that attitude, perceived e-commerce self-efficacy, perceived usefulness, perceived enjoyment, and perceived ease of use account for 52.7% of the variance in behavioral intention in our sample.

The most dominant determinant of behavioral intention was attitude, with an effect of 0.51 (Table 6). It indicates that a favorable attitude toward agricultural e-commerce has a substantial impact on the intention to use it.

The second dominant determinant of behavioral intention was perceived e-commerce self-efficacy with a total effect of 0.47. This finding is consistent with existing research showing a relationship between

perceived self-efficacy and intention (e.g., Ranganathan & Jha, 2007; Faqih, 2013; Suryani et al., 2020). PU, PE, and PEU had total effects of 0.42, 0.34, and 0.15 on intention, respectively. Together, these five variables (attitude, perceived e-commerce self-efficacy, perceived usefulness, perceived enjoyment, and perceived ease of use) accounted for 52.7% of the variance in the behavioral intention to use agricultural commerce, and just over 47% of the variance was left unexplained. This shows that the extended TAM by adding perceived self-efficacy and perceived enjoyment is a suitable model to explain farmers' intention to apply agricultural e-commerce.

The most dominant determinant of attitude was perceived usefulness with a total effect of 0.37. This shows that when farmers perceive agricultural e-commerce to be more useful, their attitude towards it improves significantly. The path from perceived usefulness to intention is also positive (0.24) and significant (t-value = 3.56). This means that perceived usefulness influences users' intention to use the system, albeit to a lesser extent than it influences attitude.

Table 1. The measurement model of the research

Component	Factor loading (λ)	Composite reliability (CR)	Average of variance extracted (AVE)
PU: α= 0.81		0.78	0.65
PU1	0.86 ***		
PU2	0.72 ***		
PU3	0.70 ***		
PU4	0.93 ***		
PEU: α= 0.75		0.84	0.64
PEU1	0.83 ***		
PEU2	0.71 ***		
PEU3	0.87 ***		
PE: α= 0.72		0.75	0.62
PE1	0.94 ***		
PE2	0.72 ***		
PE3	0.70 ***		
PES: α= 0.77		0.88	0.68
PES1	0.93 ***		
PES2	0.71 ***		
PES3	0.83 ***		
PES4	0.82 ***		
Attitude: α= 0.85		0.94	0.68
Attitude1	0.85 ***		
Attitude2	0.94 ***		
Attitude3	0.87 ***		
Attitude4	0.76 ***		
Attitude5	0.70 ***		
Intention: Cronbach's α= 0.78		0.87	0.65
Intention1	0.87 ***		
Intention2	0.81 ***		
Intention3	0.72 ***		
Intention4	0.75 ***		
Intention5	0.89 ***		
Intention6	0.79 ***		

PU: perceived usefulness; PEU: perceived ease of use; PE: perceived enjoyment; PES: perceived e-commerce self-efficacy
*** $P < 0.001$

Table 2. The results of Pearson correlation of the variables

Component	AVE	PU	PEU	PE	PES	Attitude	Intention
PU	0.65	0.78					
PEU	0.64	0.59**	0.78				
PE	0.62	0.35*	0.61**	0.73			
PES	0.68	0.40**	0.66***	0.54**	0.86		
Attitude	0.68	0.60**	0.52**	0.53**	0.44**	0.86	
Intention	0.65	0.30**	0.50**	0.37**	0.57**	0.64***	0.87

PU: perceived usefulness; PEU: perceived ease of use; PE: perceived enjoyment; PES: perceived e-commerce self-efficacy
* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table 3. The personal characteristics of the participants

Component	%	Mean
Age (years)		43.2
≤ 32	18.3	
33-45	42.8	
46-58	28.6	
59 and more	10.3	
Education (years)		-
Under diploma	63.3	
Diploma or associate degree	30.0	
Bachelor's degree or more	6.7	
Farming experience (years)		16.7
≤ 12	33.6	
13-22	44.8	
23-32	14.7	
33 and more	6.9	
Monthly income (Million Rial)		1.7
≤ 1	3.3	
1.001- 2.5	40.3	
2.501-4	44.5	
4.001 and more	11.9	
Garden size (Hectare)		1.4
≤ 5	60.8	
6-11	33.1	
12 and more	6.1	

Table 4. A summary of descriptive finding

Component	Mean	S.D
PU	3.50	0.84
PEU	2.97	0.87
PE	3.37	1.04
PES	2.18	1.06
Attitude	3.37	0.84
Intention	3.26	0.97

PU: perceived usefulness; PEU: perceived ease of use; PE: perceived enjoyment; PES: perceived e-commerce self-efficacy
Scale: 1-5

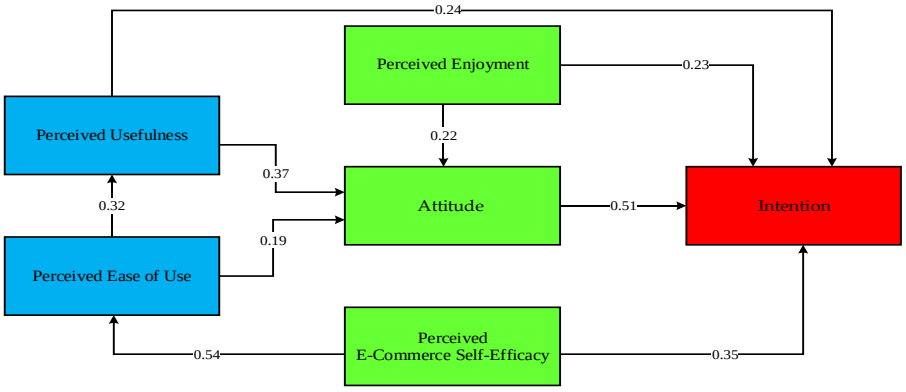

Fig. 2. The model of best-fit.

Table 5. The result of hypothesis testing

Path			Hypothesis	Standardized path coefficient	t-value
PU	→	Attitude	H1	0.37**	7.19
PU	→	Intention	H2	0.24**	3.56
PEU	→	Attitude	H3	0.19**	3.24
PEU	→	Perceived usefulness	H4	0.32**	4.78
PE	→	Attitude	H5	0.22**	3.32
PE	→	Intention	H6	0.23**	3.50
PES	→	Perceived ease of use	H7	0.54**	7.65
PES	→	Intention	H8	0.35***	6.66
Attitude	→	Intention	H9	0.51***	7.51

PU: perceived usefulness; PEU: perceived ease of use; PE: perceived enjoyment; PES: perceived e-commerce self-efficacy
***P <0.01* ****P <0.001*

Table 6. A summary of the effects of the variables

Path		Standardized estimate		
		Direct	Indirect	Total
Intention (R^2 = 0.527)	ATT	0.51	-	0.51
	PU	0.24	0.18	0.42
	PEU	-	0.15	0.15
	PE	0.23	0.11	0.34
	PES	0.35	0.12	0.47
Attitude (R^2 = 0.444)	PU	0.37	-	0.37
	PEU	0.19	-	0.19
	PE	0.22	-	0.22
Perceived usefulness (R^2 = 0.185)	PEU	0.32	-	0.32
Perceived ease of use (R^2 = 0.238)	PES	0.54	-	0.54

PU: perceived usefulness; PEU: perceived ease of use; PE: perceived enjoyment; PES: perceived e-commerce self-efficacy

Overall, the three determinants (perceived usefulness, perceived enjoyment, and perceived ease of use) accounted for 44.4% of the variance in attitude. In summary, this finding highlights the importance of these three factors in shaping attitudes and shows that they are critical elements that should be considered in any strategy related to the development of agricultural e-commerce among farmers.

Perceived ease of use had a direct effect of 0.32 on perceived usefulness. This result is consistent with the TAM. In more detail, this means that individuals who find certain technology easy to use are likely to view it as more useful in achieving their goals or tasks. Perceived e-commerce self-efficacy had a significant and direct effect on perceived ease of use (Fig. 2). This result supports existing research that indicates the effect of perceived self-efficacy on perceived ease of use (Ramayah & Aafaqi, 2004; Abdullah et al., 2016; Zhang et al., 2017).

CONCLUSION

The emergence of e-commerce has motivated widespread global research aimed at advancing our understanding of e-commerce acceptance and usage in varying environmental settings. The major contribution of this survey was to empirically improve a theoretical framework to identify the citrus growers' intention to use agricultural e-commerce. A conceptual research model was used based on the extended form of the TAM by adding two external variables (perceived e-commerce self-efficacy and perceived enjoyment). Quantitative data were collected with a questionnaire. In total, the findings illustrated that the extended TAM was significant in explaining citrus producers' intentions. Attitude to use, perceived e-commerce self-efficacy, PU, PE, and PEU explained 52.7% of the variance in behavioral intention. Therefore, about 53% of the variance in intention was explained by the model, which is a relatively strong explanatory power. The developed TAM presented in this research can be used by agricultural e-commerce promoters to improve appropriate factors to increase farmers' intention to apply agricultural e-commerce in the future.

Therefore, agricultural e-commerce practitioners have to concentrate on the variables of attitude, perceived e-commerce self-efficacy, perceived usefulness, perceived enjoyment, and PEU to improve farmers' intention to apply agricultural e-commerce. The findings are in line with the results of some studies such as Hailemariam et al. (2024), Agarwal and Karahanna (2000), Khan et al. (2024), Pan (2024), Sönmez et al. (2024), Thongsri et al. (2019), and Singh and Srivastava, (2020).

There was a main impact of attitude on citrus producers' behavioral intention. Therefore, improving farmers' attitudes towards using agricultural e-commerce through extensional and educational programs is recommended.

Also, attitude itself is influenced by perceived usefulness, perceived ease of use, and perceived enjoyment. In summary, attitude toward agricultural e-commerce is influenced by how useful, easy to use, and enjoyable farmers perceive the agricultural e-commerce experience is. A positive outlook in these areas will likely encourage more frequent and enthusiastic use of agricultural e-commerce activities.

Perceived e-commerce self-efficacy is considered the second most important variable that directly affects the intention. This underlines the importance of self-efficacy for participation in agricultural e-commerce. In practical terms, improving users' self-efficacy through training can increase their intention to interact with agricultural e-commerce.

Moreover, our study demonstrated that perceived e-commerce self-efficacy had a direct impact on PEU. This result illustrates that when farmers believe that they have the adequate aptitudes and skills to succeed in e-commerce, they come into a stronger belief that the use of e-commerce will be effortless.

It should be noted that perceived self-efficacy as a variable added to the TAM has been widely confirmed by some studies such as Igbaria and Iivari (1995), Rahmawati (2019), Chen et al. (2022), and Silvertre et al. (2022).

PE was also a predictor of farmers' attitudes and intentions, confirming the role of intrinsic motivation in increasing attitudes and intentions to use agricultural e-commerce. It should be noted that the role of PE as a variable added to the TAM has extensively been validated and confirmed by studies on IT (Yu, 2005; Suki & Suki, 2011; Cheema, 2013; Alalwan et al., 2018; Manis & Choi, 2019). Therefore, policymakers in the agricultural sector can focus on designing educational programs that also highlight the enjoyable aspects of using e-commerce. This can lead to increased adoption of agricultural e-commerce among farmers.

Finally, 47% of the variance in behavioral intention is unexplained in our proposed model. Therefore, it is

recommended to conduct more research on the behavioral intention of farmers to adopt agricultural e-commerce.

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CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Conceptualization: Raha Zarei and Gholam-Hossein Zamani; Methodology: Raha Zarei and Gholam-Hossein Zamani; Software: Raha Zarei, Hamid Karimi, and Pouria Ataei; Validation: Raha Zarei, Gholam-Hossein Zamani, and Hamid Karimi; Formal analysis: Raha Zarei; Investigation: Raha Zarei and Gholam-Hossein Zamani; Resources: Raha Zarei and Gholam-Hossein Zamani; Data curation: Raha Zarei and Hamid Karimi; Writing-original Draft preparation: Raha Zarei; Writing-review and Editing: Raha Zarei, Hamid Karimi, and Pouria Ataei; Visualization: Pouria Ataei; Supervision: Gholam-Hossein Zamani; Project administration: Raha Zarei and Gholam-Hossein Zamani.

DECLARATION OF COMPETING INTEREST

The authors declare no conflict of interest.

ETHICAL STATEMENT

In this study, no human or animal experiments were performed.

DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author upon request.

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