International Journal of Agricultural Management and Development
Available online on: www.oiccpress.com/ijamad
ISSN: 2159-5852 (Print)
ISSN:2159-5860 (Online)

Original Paper *https://doi.org/10.71877/ijamad.2024.8277*

Investigating Factors Affecting the Adoption of Environmentally Friendly Agricultural Practices in Paddy Farms of Iran

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Received: 05 April 2023,
Accepted: 31 May 2024

Abstract

Increasing environmental challenges and various shocks have caused significant changes in economic sectors. The use of traditional and non-scientific agricultural methods by paddy farmers, along with the widespread use of chemical fertilizers and pesticides in paddy cultivation, has exacerbated environmental crises in Guilan Province. This study analyzed the factors influencing the adoption of environmentally friendly agricultural practices (EFAPs) among paddy farmers in Northern Iran using an attitude-based conceptual model. For the first time, two conceptual models—the Theory of Planned Behavior (TPB) and the model of resilience capacities—were integrated to form a coherent framework affecting the adoption of EFAPs through Structural Equation Modeling (SEM). The sample size was determined using the Soper (2021) calculator. The study was conducted in the Lasht-e-Nesha district of Guilan Province, located in the northernmost part of Iran, where 200 paddy farmers were interviewed in person using a standardized questionnaire. The results showed that farmers' intention, perceived behavioral control, perceived ecological benefits, attitudes, information resources, and the transformability aspect of resilience have a positive and statistically significant effect on the adoption of EFAPs. The findings provide a comprehensive framework for the effective design of policies promoting the adoption of new technologies related to EFAPs.

Keywords:
Partial least squares; resilience; attitude components; paddy; adoption

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INTRODUCTION

Modern agriculture, which has become very widespread in recent years, has focused on the intensive use of fertilizers, chemical pesticides, and industrial machinery, resulting in the pollution of natural resources, including water and soil (Tagg et al., 2021; Jia et al., 2019). Another negative effect of modern agriculture is the risk it poses to the health of consumers of agricultural products. Residues of pesticides and chemical fertilizers on these products enter the human body and can cause serious health problems (Carne et al., 2021; Ugulu et al., 2021). Plant and animal species have also been affected by this agricultural development, and in recent years, the decline in biodiversity has sharply increased (Belachew et al., 2020; Concepción et al., 2020; Jia et al., 2019).

The agricultural sector in most developing countries is recognized as one of the major contributors to adverse environmental effects. Additionally, rising temperatures and climate change are expected to severely impact agricultural production (Hu and Xiong, 2014). In response, strategies known as environmentally friendly agricultural practices (EFAPs) have been developed and implemented to mitigate and minimize the destructive environmental effects of agricultural activities and modern farming methods (Roos et al., 2019; Mozzato et al., 2018). EFAP measures promote eco-friendly agriculture based on principles of adaptation and the reduction of negative impacts on natural resources and the environment. Adaptation can occur at various levels, including national, individual, farm, or farmer levels. However, not all adaptation-based techniques are environmentally friendly, as agricultural activities are a major source of carbon dioxide emissions and account for up to 24 percent of total greenhouse gas emissions (Mustafa et al., 2021; Smith et al., 2014; Tilman and Clark, 2014). Therefore, EFAP techniques should be carefully designed and introduced to ensure maximum environmental friendliness and minimal environmental hazards.

Another definition of EFAPs is a set of agricultural measures that enhance the ecosystem services of the agricultural sector while significantly reducing its vulnerability to climate change and rising temperatures (Mozzato et al., 2018). According to Sapkota et al. (2015), the use of EFAPs can reduce production costs by up to 23 percent, thereby mitigating the effects of rising temperatures.

Various measures have been implemented worldwide to promote EFAPs. In Europe, efforts to preserve biodiversity have included allocating at least 10% of arable land to areas with high landscape diversity, dedicating 25 percent of arable land to organic cultivation, and reducing the use of fertilizers and chemical pesticides in agricultural production by 50 percent (European Commission website, 2021).

In the Americas, the Institute for Sustainable Agricultural Research and Education (SARE) has promoted innovation in EFAPs by providing funding and training programs (U.S. Department of Agriculture, 2021). American farmers are also increasing crop yields, using more conservation tillage, adopting conservation practices, and actively working to preserve natural resources. These efforts have led to reduced soil erosion, improved soil fertility, enhanced water quality, and significantly lower greenhouse gas emissions (The American Farm Bureau, 2021).

In both developed and developing countries, governments have supported the advancement and promotion of EFAPs through financial incentives and assistance (Fahad et al., 2021). However, research shows that financial and economic support alone is not sufficient to increase the adoption rate of EFAPs. The foundation of this change lies in farmers' attitudes and behavioral intentions (Faridi et al., 2020; Friedlander et al., 2013; Teklewold et al., 2013; Nyanga, 2012; Yiridoe et al., 2010; Läpple, 2010; Upadhyay et al., 2003). Numerous variables and factors influence this process and must be taken into account (Blazy et al., 2011).

In recent decades, the primary focus of agricultural economics and rural development researchers on EFAPs has generally centered on quantitative and demographic variables such

as age, farm size, access to credit, and production rate (Faridi et al., 2021; Magruder, 2018; Amsalu and De Graaff, 2007; Kassie et al., 2015; Kpadonou et al., 2017). However, experience has shown that the adoption process of EFAPs is far more complex and involves additional factors, including attitudinal and behavioral components (Beedell and Rehman, 2000; Wilson and Hart, 2000; Vanslembrouck et al., 2002; Tadesse and Belay, 2004; Defrancesco et al., 2008; Pascucci et al., 2013; Emery and Franks, 2012; Ma et al., 2012; Home et al., 2014; Price and Leviston, 2014). Studies in this area have employed various quantitative and qualitative research methods, including structural equation modeling (Menozzi et al., 2015; Cakirli Akyüz and Theuvsen, 2020; Faridi et al., 2020) and regression techniques such as logit and probit models (Amsalu and De Graaff, 2007; Kassie et al., 2015; Kpadonou et al., 2017).

This study aims to examine the factors influencing the adoption of EFAPs using an attitude-based conceptual model. What distinguishes this research from previous studies is the integration of resilience components into the core conceptual framework.

Rice is one of the primary crops in Asian and African countries, feeding more than half of the population across these two continents (Li et al., 2020). Global rice production is expected to increase by 2 percent in the coming decades to meet the demands of a growing population (Yao et al., 2017). However, rice is also one of the largest contributors to greenhouse gas (GHG) emissions among agricultural crops, accounting for approximately 10 percent of the methane (CH_4) released into the Earth's atmosphere (Maraseni et al., 2018). Activities carried out by paddy farmers during cultivation also generate substantial amounts of carbon dioxide. Additionally, rice crop residues—whether burned or left to decompose—emit methane and nitrous oxide (Shahane et al., 2019). Therefore, in the rice production process, farmers must adopt practices that reduce harmful gas emissions, conserve natural resources, and enhance both productivity and profitability.

In 2019, Iran's paddy production reached 1.99 million tons (USDA, 2019). Guilan province, located in the northernmost part of the country, is one of Iran's leading rice-producing regions. However, the excessive use of chemical fertilizers and pesticides in rice cultivation has polluted water and soil resources, endangered biodiversity, and contributed to the spread of disease among farmers (Motevali et al., 2019). Pesticide use is considered an essential component of current paddy farming, with 60 percent of the total pesticide consumption occurring in the northern provinces—Guilan, Mazandaran, and Golestan—where rice cultivation is dominant. Indiscriminate pesticide application has caused environmental harm, including the destruction of beneficial insects and organisms in paddy fields, as well as a high incidence of digestive tract cancer in these regions. Despite these consequences, the use of chemical pesticides continues to rise due to their economic benefits, accessibility, efficiency, and versatility, with no clear trend toward reduced consumption (Niyaki et al., 2010). Therefore, this study aims to investigate the factors influencing the adoption of EFAPs among paddy farmers in Guilan province and, based on the findings, offer policy recommendations for the development and promotion of EFAPs.

The significant influence of attitudinal and behavioral components on the acceptance or rejection of new technologies and innovative practices has been well established in recent years. Researchers have employed various conceptual models grounded in attitudinal factors in their studies (Faridi et al., 2020; Andrews et al., 2021; He et al., 2020; Dasgupta and Gupta, 2019; Diekmann and Theuvsen, 2019; Lili et al., 2021). However, there is growing consensus among researchers across disciplines that relying on a single conceptual model (e.g., UTAUT or TRA) is insufficient for an in-depth, accurate, and comprehensive understanding of such phenomena. As a result, the integration of multiple conceptual models is now recommended (Cakirli Akyüz and Theuvsen, 2020; Faridi et al., 2020; Oliveira et al., 2014).

Accordingly, this study integrates two con-

ceptual models—the Theory of Planned Behavior (TPB) and the model of resilience capacities—to more thoroughly examine the factors influencing the adoption of EFAPs. TPB, introduced by Ajzen and Fishbein in 1980, posits that individual behavior stems from multiple factors. This theory classifies the determinants of behavior into three broad categories: 1) Beliefs about the outcomes of performing a specific behavior, which shape an individual's positive or negative attitude toward that behavior. 2) Normative beliefs which are individuals' beliefs about the extent to which other people who are important to them think they should or should not perform particular behaviors. 3) Control beliefs that facilitate the formation or non-formation of a particular behavior (Fishbein and Ajzen, 1975).

The resilience capacity model is also included in the main conceptual model of this research. Resilience refers to the capacity of a physical or socio-ecological system to recover from disturbances and maintain its normal function. The resilience model consists of three key components: the ability to return from an unbalanced or disruptive state, known as persistence; the capacity to adapt, referred to as adaptability; and the ability to undergo transformation, termed transformability (Roberts et al., 2021; Walker et al., 2004; Folke et al., 2010; Darnhofer et al., 2016). The emphasis of the resilience model is on change, uncertainty, and a system's ability to adapt (Holling and Gunderson, 2002). To strengthen the predictive power of the conceptual model, three variables—perceived ecological benefits, social features, and information resources—have been added to this study's conceptual framework. The following sections will explain each component in detail and present the hypotheses derived from them.

Subjective norm (SN)

SN refers to the attitude and way of thinking of a person towards those around them in relation to performing a particular action (Fishbein and Ajzen, 1975). According to Miller (2005), SN is a type of mental norm that asserts those around a person play a positive and decisive role in shaping their intentions. In the TPB, it is assumed that when a person interacts with different people, they will adjust their thoughts and actions accordingly, with these individuals playing a key role in altering attitudes and beliefs (Park, 2000). In this study, the SN variable seeks to examine the extent to which those around the paddy farmer can influence the process of adopting

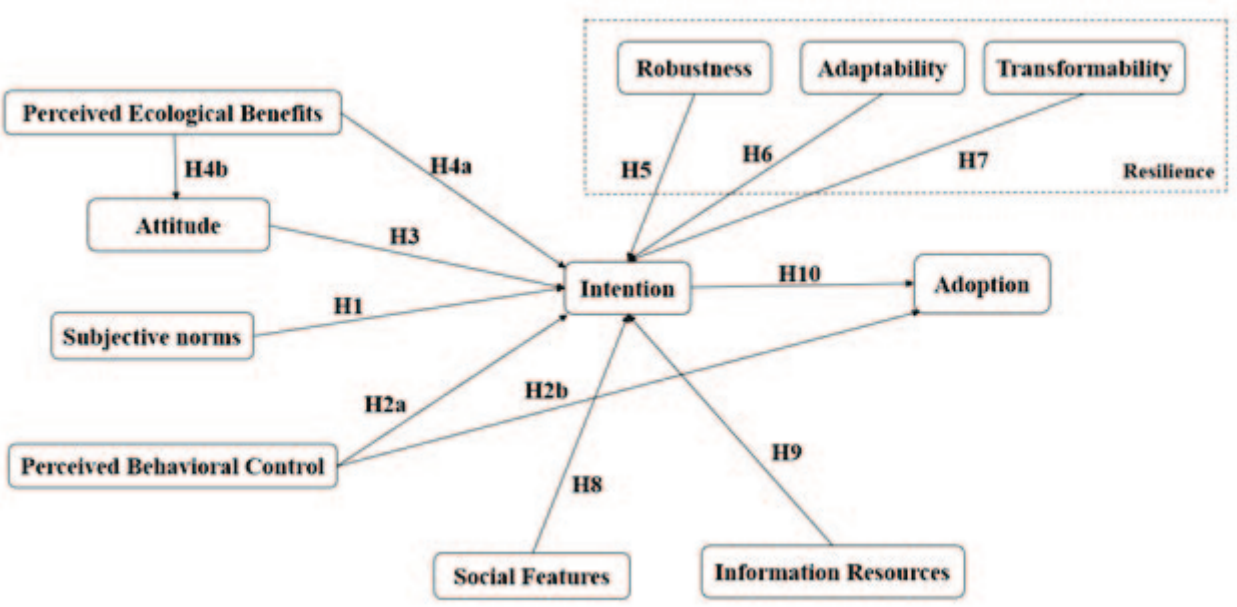

Figure1. Conceptual Model of Research.

EFAPs, and how effective they are in this process. Numerous studies have concluded that SN has a positive and significant effect on people's intention to adopt new services, technologies, or actions (Cakirli Akyüz and Theuvsen, 2020; Wollni and Andersson, 2014; Bjørkhaug and Blekesaune, 2013; Heyder et al., 2012; Getz and Shreck, 2006).

Therefore, the first hypothesis that is proposed in this study is:

Hypothesis 1 (H1): SN has a positive and significant effect on paddy farmer's intention towards EFAPs adoption.

Perceived behavioral control (PBC)

PBC refers to an individual's attitudes and perceptions about the difficulty or ease of performing an action, behavior, or technology, and generally relates to an individual's assessment of these situations (Fishbein and Ajzen, 2010). Studies that have used PBC as one of the components influencing behavioral intention have concluded that as PBC increases, behavioral intention also increases (Aitken et al., 2020; Yadav and Pathak, 2016a, b; Al-Swidi et al., 2014; Padel and Foster, 2005). In the present study, PBC represents the assessment of paddy farmers' knowledge and the resources they possess in order to implement EFAPs.

Therefore, the hypothesis that is put forward in relation to PBC is as follows:

Hypothesis 2a (H2a): PBC has a positive and significant effect on paddy farmer's intention towards EFAPs adoption.

Hypothesis 2b (H2b): PBB has a direct and positive effect on farmers towards EFAPs adoption.

Attitude (AT)

Attitude is a combination of beliefs and emotions that prepares a person in advance to view others, objects, and groups in a positive or negative way (Fishbein and Ajzen, 1975; Davis, 1989). In this study, AT refers to the paddy farmer's predictions of their future situation as a result of accepting or not accepting EFAPs. These forecasts can be optimistic or pessimistic, which ultimately have a significant impact on the farmer's decision to adopt EFAPs. Given the crucial role of AT, the hypothesis that arises in this regard is as follows:

Hypothesis 3 (H3): AT has a positive and significant effect on paddy farmer's intention towards EFAPs adoption.

Perceived ecological benefits (PEB)

When it comes to adopting new technology or practices, the term perceived, or perceived ease, refers to the benefits that a person derives from adopting a technology, product, or measure (Jiang et al., 2021; Dunlap et al., 2000). In other words, the user understands that by accepting a service or product, he/she will receive a wide range of benefits (Pei et al., 2015). In this study, because the main purpose is to examine the factors affecting the acceptance of EFAPs, PEB seeks to examine paddy farmers' perceptions of the ecological benefits of using environmentally friendly measures. Thus, the hypotheses raised in relation to PEB are as follows:

Hypothesis 4a (H4a): PEB has a positive and significant effect on paddy farmer's intention towards EFAPs adoption.

Hypothesis 4b (H4b): PEB has positively facilitates paddy farmer's attitude towards EFAPs adoption.

Robustness (ROB)

The inherent ability of a system to withstand failures, harsh conditions, and errors is called robustness (The system can include a variety of concepts; in this study, we mean the paddy field) (AL, 2002; Mahmoudi et al., 2021). Paddy farmers in Iran, during the growing season, always deal with many risks that can make growing conditions challenging for them. Adverse conditions such as pest outbreaks, droughts, storms, and fluctuations in agricultural input prices can severely affect farm performance (Saber et al., 2021). In this study, ROB seeks to measure and evaluate farmers' assessment of their resilience to these harsh and challenging conditions. The hypothesis designed in relation to this component is also presented below:

Hypothesis 5 (H5): ROB has a positive and significant effect on paddy farmer's intention

towards EFAPs adoption.

Adaptability (ADA)

If a system has the ability to manage the risks posed by sudden stresses and shocks, without changing the capacity of inputs, production, and marketing, it is said that the system has adaptability (Rivera et al., 2021). In this study, ADA seeks to assess paddy farmers' attitudes toward how much they perceive their paddy farms and natural resources as adaptable to challenging conditions and whether they are able to cope after a severe crisis and return to normal conditions. It is therefore assumed that the more positive a paddy farmer's assessment of his/her self and his/her paddy farm's adaptability, the greater the behavioral intention to adopt EFAPs.

Hypothesis 6 (H6): ADA has a positive and significant effect on paddy farmer's intention towards EFAPs adoption

Transformability (TRA)

If a system is exposed to severe shocks or sustained pressures over a period of time, and has the ability to change its internal structure and feedback mechanisms to suit new conditions, it is said it has transformability capacity (Olazabal, 2017; Tittonell, 2014). Using TRA in this study, it will be determined to what extent paddy farmers see the potential in themselves to change according to the new, unfavorable and critical conditions, and still be productive and profitable. Thus, it is assumed that the positive attitude of paddy farmers towards the TRA component facilitates their behavioral intention to adopt EFAPs.

Hypothesis 7 (H7): TRA has a positive and significant effect on paddy farmer's intention towards EFAPs adoption

Social Features (SF) and Information Resources (IR)

SF refers to the willingness of paddy farmers to participate in community activities and local institutions to raise their awareness regarding EFAPs. The impact of the paddy farmer's interaction with other farmers and institutions responsible for promoting EFAPs is also measured using the SF component.

IR also seeks to address the extent to which farmers are concerned about information and awareness of the various aspects of EFAPs and are constantly increasing their knowledge in this area. The effect of these two components on adoption was investigated in the study conducted by Ankamah et al. (2021) and the results showed that SF and IR both have a positive and significant effect on the acceptance of EFAPs. Thus, the final hypotheses of this research were designed as follows:

Hypothesis 8 (H8): SF has a positive and significant effect on paddy farmer's intention towards EFAPs adoption

Hypothesis 9 (H9): IR has a positive and significant effect on paddy farmer's intention towards EFAPs adoption

Intention (IN)

A person may perform in the future certain behaviors under certain circumstances in connection with a new system, service, or measure and have now the thought of doing them in mind. These thoughts, which pave the way for certain behaviors in the future, are called behavioral intentions (Venkatesh et al., 2003). Various studies have been conducted to investigate the effect of IN on adoption, and in most of them, IN has been identified as one of the positive and effective explanatory variables (Faridi et al., 2020; Ajzen, 1991; Chau and Hu, 2002; Venkatesh and Davis, 2000; Venkatesh et al., 2003; Kijsanayotin et al., 2009). In this study, the variable BI indicates the intention of farmers to adopt EFAPs soon and implement these measures on their farms. The issues raised in this section led us to conclude the following hypothesis of this research:

Hypothesis 10 (H10): IN has a direct and positive effect on farmers towards EFAPs adoption.

METHODOLOGY

Area of study

This study was conducted in the Lasht-e-Nesha district of Guilan province, located in the northernmost point of Iran. Lasht-e-

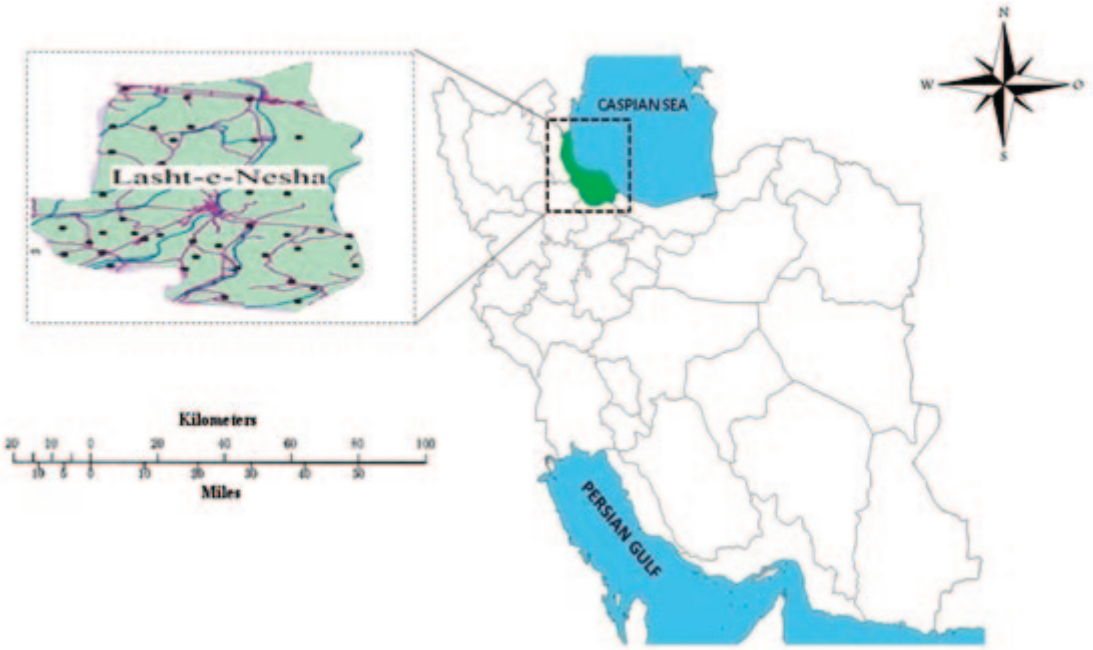

Figure2. Location of Lasht-e-Nesha Area in Northern Iran.

Nesha has a temperate and humid climate, with the highest and lowest recorded temperatures for the region reported to be 6.17°C and -3°C, respectively. The proximity of this area to coastal regions has resulted in precipitation predominantly occurring in the form of rain rather than snow. Adequate rainfall and fertile soil have enabled farmers to cultivate a wide range of crops and orchards, with rice being one of the main crops produced in this area. The main reason for selecting this area as a case study in this research is the large number of paddy farmers active in the region and the extensive area dedicated to rice cultivation.

Sampling process, data collection, and research tools

In the Lasht-e-Nesha district, 8,350 hectares of paddy land are cultivated annually, and 11,614 paddy farmers are engaged in rice cultivation in the area (Jihad Agriculture Organization of Guilan Province, 2020). The data used in this study were collected in the summer of 2021 by an experienced interview team from the rural areas of the Lasht-e-Nesha district. The target population for this study consists of paddy farmers living in Lasht-e-Nesha. To determine the sample size, an online calculator presented by Soper (2021) was used, chosen specifically for the implementation of structural equation modeling in data analysis. The related formulas for this online calculator are described in Westland (2010). The sample size determined was 200 paddy farmers.

Paddy farmers were interviewed in person using a standard questionnaire (Aitken et al., 2020; Saber et al., 2021; Jiang et al., 2021), with questions relevant to the variables presented in the conceptual model section. Because of the standard nature of the questionnaire, it was not necessary to conduct a validity check; only the reliability of the questionnaire was assessed, and it was found to be acceptable. The first part of the questionnaire collected personal information about the paddy farmers, such as age, income, and production rate. In the second part, attitudinal questions related to different aspects of EFAPs were asked, using a 5-point Likert scale.

In this study, eight EFAPs were considered, and each paddy farmer was asked, through a two-option question, whether they implemented any of these measures on their paddy

fields. The actions referred to as EFAPs in this study are as follows: Second cultivation after rice, avoid burning crop residues after harvest, perform plowing at the appropriate depth and time, implement protective tillage on sloping parts of paddy fields, use soil testing to determine the fertilizer requirements of paddy fields, collect and recycle empty pesticide containers, avoid releasing household waste into paddy fields, avoid using sewage water to irrigate paddy fields.

Data analysis

After collecting data from rural areas, the next step was to analyze the data and convert it into usable information. First, the data were entered into SPSS software, where scaling, labeling, and naming of all variables were performed. In this study, the method used for data analysis was structural equation modeling (SEM). One of the key advantages of using SEM over other quantitative and qualitative methods is its ability to comprehensively study the impact of latent variables on the formation of a specific phenomenon (Hair et al., 2011; Chin, 2002). PLS-SEM, a variance-based method, is not sensitive to sample size and provides reliable results regardless of data normality (Sarstedt, 2008; Vinzi et al., 2010). To implement the PLS-SEM approach, Smart-PLS3 software was used. After entering the data and creating a new project in the software, two key steps were followed to obtain results and determine the effect of each latent variable:

Step 1: Ensure the reliability of the measurement model used in the study. As described in the conceptual framework section, the components and their interrelationships were clearly outlined. The PLS-SEM approach evaluates whether the items used to measure the effects of components in the conceptual model accurately capture these effects. Smart-PLS provides specific indicators to verify the reliability and descriptive validity of the measurement model.

These indicators are as follows:

Cronbach's alpha index: Values above 0.7 are acceptable.

Composite Rreliability index (CR): Values above 0.7 are acceptable.

Average Variance Extracted index (AVE): Values above 0.5 are acceptable.

Outer loadings: Values above 0.4 are acceptable (Bagozzi et al., 1991).

When all the indicators mentioned above are in the acceptable range, it means that the measurement model used has acceptable internal consistency and can be used in the structural model (second step).

Step 2: After ensuring the reliability of the measurement model, the software processes the structural model and reports the path coefficients of the latent variables and the coefficients of determination for the dependent variables. Using the path coefficients, the hypotheses proposed in the research can be accepted or rejected. Finally, to assess the significance of each latent variable, Smart-PLS software uses the Bootstrapping feature along with the P-value index (Chin, 2002; Hair et al., 2011).

RESULTS

The frequency of demographic characteristics of the sample paddy farmers include age, schooling, use of family labor, type of land tenure, gender and paddy farm slope were presented in Table 1.

Assessment of the measurement model

To evaluate the measurement model, the CR, AVE, outer loading and discriminant validity indices were calculated. Table 1 shows the results of these indicators in detail.

In addition, all the attitudinal components used in the research model fall within the acceptable range of measurement criteria (e.g., Cronbach's alpha, CR, and AVE) (Bagozzi and Yi, 1988; Gefen et al., 2000; Nunnally, 1979). Based on the results, the validity of the measurement model is confirmed. Accordingly, the attitudinal variables introduced in the conceptual model were evaluated. The final model estimated using Smart-PLS software, along with all path coefficients, is presented in Figure 3. The goodness-of-fit criteria for the structural model were evaluated using Amos software version 21, and the results are reported in Table 3. This software offers a

Table 1
Distribution of Survey Respondents (n=200)

Variables	Category	Frequency	Percentage
Age (years)	20-29	42	2
	30-39	27	13.5
	40-59	130	65
	>60	39	19.5
Schooling	Lower than Diploma	98	49
	Diploma or higher	102	51
Use of family labor	Yes	19	99.5
	No	91	0.5
Type of land tenure	Ownership	133	66.5
	Rent	23	11.5
	Sharing	44	22
Gender	Male	132	66
	Female	68	34
Paddy farm slope	Yes	34	17
	No	166	83

wide range of fit indices, all of which fall within acceptable limits, indicating a good fit for the structural model.

In the final step, discriminant validity was evaluated using two measurement criteria. The first criterion is that the outer loading of each variable must be greater than its cross-loading. The second is that the square root of the AVE for each variable must exceed the correlation of that construct with other variables (Fornell and Larcker, 1981). The analysis of discriminant validity is presented in Table 4. Based on the results for AVE, CR, and Cronbach's alpha indices, the research model demonstrates good internal consistency, favorable discriminant validity, and reliability. This confirms that the measurement model is statistically sound and suitable for use in the structural model.

Evaluation of the structural model

PLS-SEM does not assume a normal distribution of data, meaning that traditional significance tests used in regression analysis cannot be applied to evaluate the significance of coefficients such as outer loadings and path coefficients. Instead, PLS-SEM employs a non-parametric bootstrap procedure to assess parameter significance. Based on the R^2 values reported in Table 4, the research model effectively explains the variations in resilience, behavioral intention, and the adoption of EFAPs. The final model, including the path coefficients for the dependent variables, is illustrated in Figure 3.

The variables of paddy farmer's attitude (p-value <0.01, β = 0.109), perceived behavioral control (p-value<0.01, β = 0.372), perceived ecological benefits (p-value <0.01, β = 0.204), adaptability (p-value<0.01, β = 0.097), and information resources (P-value<0.01, β = 0.137) are statistically significant and able to describe the variable of paddy farmer's intention. According to these results, H3, H2a, H4a, H6, and H9 are confirmed. This model also describes 84.1 percent of changes in behavioral intention.

Perceived ecological (p-value<0.01, β = 0.769), It is statistically significant and able to describe the attitude of paddy farmers. According to these results, H4b is confirmed. This model also describes 59.2 percent of the

Table 2
Measurement Model.

Construct	PLS code item	Cronbach's alpha	CR	AVE	Outer loading
Subjective Norm (SN)	SN1	0.706	0.790	0.569	0.510
	SN2				0.823
	SN3				0.504
	SN4				0.534
Perceived Behavioral Control (PBC)	PB1	0.722	0.756	0.509	0.758
	PB2				0.722
	PB3				0.657
Attitude (AT)	AT1	0.718	0.755	0.567	0.695
	AT2				0.744
	AT3				0.525
	AT4				0.746
Perceived Ecological Benefits (PEB)	PEB1	0.725	0.800	0.571	0.762
	PEB2				0.744
	PEB3				0.761
Robustness (ROB)	ROB1	0.741	0.746	0.529	0.597
	ROB2				0.525
	ROB3				0.737
	ROB4				0.734
Adaptability (ADA)	ADA1	0.722	0.781	0.578	0.694
	ADA2				0.769
	ADA3				0.762
	ADA4				0.507
Transformability (TRA)	TRA1	0.736	0.743	0.523	0.644
	TRA2				0.533
	TRA3				0.640
	TRA4				0.764
Social Features (SF)	SF1	0.721	0.828	0.548	0.625
	SF2				0.790
	SF3				0.795
	SF4				0.738
Information Resources (IR)	IR1	0.794	0.813	0.522	0.698
	IR2				0.708
	IR3				0.798
	IR4				0.681
Intention (IN)	IN1	0.789	0.785	0.549	0.775
	IN2				0.727
	IN3				0.719

changes in attitude of paddy farmers.

The variables of intention (p-value<0.01, β = 0.413), and perceived behavioral control (p-value<0.01, β = 0.519), are statistically significant and are able to describe the adoption of EFAPs. According to these results, H10 and H2b are confirmed. This model is able to describe 81.3 percent of changes in the adoption of EFAPs. Additionally, the results have shown that the subjective norm, adaptability, and social features are not significant and do not play a role in describing changes in paddy farmer's intention. For this reason, H1, H6, and H8 are rejected.

In this study, it was assumed that the variable of adoption is explained by three variables of robustness, intention and perceived behavioral control. According to the results

Table 3
Structural Model Goodness of Fit Criteria.

Criteria	Reported value	Suggested amount	Acceptance status
$\aleph^2$	3.8	<3 good fit <5 reasonable fit	Good
RMSEA	0.12	<0.05 good fit <0.10 reasonable fit	Reasonable
NFI	1	Above 0.9	Reasonable
CFI	1	Above 0.9	Reasonable

Table 4
Correlation of Structures by AVE Index.

	ADA	AT	IN	IR	PBC	PEB	ROB	SF	SN	TRA	Adoption
ADA	0.760										
AT	0.619	0.782									
IN	0.727	0.786	0.740								
IR	0.671	0.718	0.779	0.722							
PBC	0.712	0.770	0.873	0.740	0.713						
PEB	0.683	0.769	0.832	0.727	0.803	0.755					
ROB	0.778	0.691	0.756	0.707	0.781	0.702	0.727				
SF	0.714	0.735	0.777	0.784	0.753	0.756	0.713	0.740			
SN	0.701	0.800	0.811	0.736	0.851	0.775	0.752	0.728	0.754		
TRA	0.726	0.652	0.753	0.654	0.738	0.708	0.690	0.687	0.733	0.723	
Adoption	0.680	0.812	0.865	0.727	0.879	0.837	0.737	0.716	0.859	0.756	1

of robustness (p-value < 0.01, β = 0.519), intention (p-value < 0.01, β = 0.519), and perceived behavioral control (p-value < 0.01, β = 0.519), are statistically significant and able to describe the changes in the adoption of EFAPs. Based on the results obtained in this research, out of 12 proposed hypotheses, 8 hypotheses were proved and 4 hypotheses were rejected. The details of research assumptions and structural model results are shown in Table 5.

DISCUSSION

The results showed that the intention of paddy farmers has a positive and statistically significant effect on the adoption of EFAPs at the level of 1 percent. This finding is in line with the results of Adnan et al. (2017), Nebel et al. (2017), and Faridi et al. (2020). In this study, the direct effect coefficient of intention on adoption of EFAPs was estimated to be 0.413. In previous studies, the value of this coefficient was reported between 0.353 and 0.510 (Faridi et al., 2020; Mutyasira et al., 2018; Adnan et al., 2017).

In this study the perceived behavior control has a positive and statistically significant effect at the level of 1percent on the adoption of EFAPs the paddy farmers. This finding is in line with the results of Daniele et al. (2018). In this research, the value of the direct effect coefficient of this variable on adoption was 0.519. In past studies, the value of this coefficient was reported between 0.308 and 0.381 (Price & Leviston, 2014).

The results showed that the perceived ecological benefits has a positive and statistically significant effect at the level of 1 percent on the adoption of EFAPs by the paddy farmers. Similar results can also be found in studies conducted by Ankamah et al. (2021).

The attitude of paddy farmers has a positive

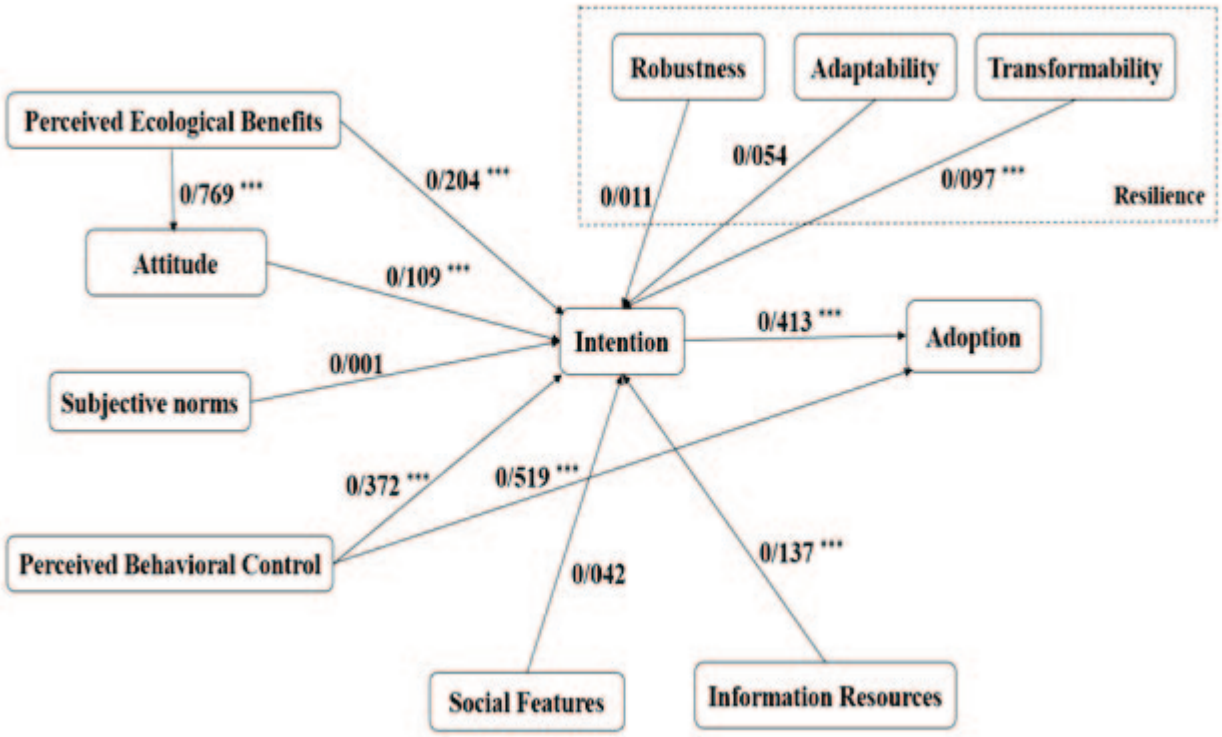

Figure3. Structural Model Results.

Table 5
Outcomes of Structural Equation Modeling Analysis.

Path	Hypothesis	Path coefficient (β)	P-Value	Supported?	R^2 (%)
Intention					
SN→IN	H_1 (+)	0.001	0.992	NO	
PBC→IN	H_{2a} (+)	0.372	0.000	YES	
AT→IN	H_3 (+)	0.109	0.07	YES	
PEB→IN	H_{4a} (+)	0.204	0.003	YES	
ROB→IN	H_5 (+)	0.011	0.850	NO	84.1
ADA→IN	H_6 (+)	0.054	0.325	NO	
TRA→IN	H_7 (+)	0.097	0.027	YES	
SF→IN	H_8 (+)	0.042	0.521	NO	
IR→IN	H_9 (+)	0.137	0.017	YES	
Attitude					
PEB→AT	H_{4b} (+)	0.769	0.000	YES	59.2
Adoption					
IN→Adoption	H_{10} (+)	0.4130.519	0.000	YES	81.3
PBC→Adoption	H_{2b} (+)		0.000	YES	

and statistically significant effect at the level of 1 percent on the adoption of EFAPs by the paddy farmers. This finding is in line with the results of Dessart et al. (2019), and Price and Leviston (2014). In this research, the value of the direct effect coefficient of this variable on adoption was 0.109. In past studies, the value of this coefficient was reported between

0.149 and 0.715 (Dessart et al., 2019; Price & Leviston, 2014).

The results showed that the information resource component has a positive and statistically significant effect at the level of 1 percent on the adoption of EFAPs by the paddy farmers. Similar results can also be found in studies conducted by Wang et al. (2016). In this study, the direct effect coefficient of intention on adoption of EFAPs was estimated to be 0.137.

CONCLUSIONS

It is recommended to increase paddy farmers' familiarity with the benefits and importance of EFAPs through promotional and educational courses in rural areas. Experts should also train farmers on the proper implementation of these practices. When farmers are confident in the ease of implementing EFAPs, their adoption is more likely. Additionally, enhancing farmers' awareness of the environmental benefits can build initial trust, ultimately leading to a stronger behavioral intention to adopt these practices.

The findings of this research provide a useful empirical framework for future studies on EFAP adoption. A key achievement of this study, not emphasized in earlier research, is the significant role of resilience in the adoption process. This highlights the importance of resilience as a determinant and calls for appropriate policymaking to enhance paddy farmers' resilience through targeted support from local authorities and planners.

Attention to attitudinal components influencing EFAP adoption is essential for agricultural policymakers, institutions, and decision-makers to ensure the success of extension strategies. Farmers often evaluate EFAPs in terms of the value and benefits they can gain. Establishing model farms that implement EFAPs in rural areas can demonstrate tangible results and benefits, fostering trust and encouraging adoption. When farmers see their expectations met, their willingness to embrace EFAPs increases.

Given the positive impact of information resources on EFAP adoption, raising awareness about the environmental consequences of farming practices through various media can cultivate a sense of responsibility. This awareness can drive farmers toward more environmentally responsible behavior. Educational initiatives should emphasize the direct and indirect harm caused by unsustainable practices, fostering moral and ethical engagement with environmental conservation. This study can serve as a reference for future investigations into the adoption of technologies related to EFAPs. The model and approach used here enable analysis of the combined effects of environmental, behavioral, financial, and social factors on adoption decisions.

Limitations of the research included restricted funding, the wide dispersion of farmers, limited access to many of them, and the shortage of skilled interviewers, which affected the ability to expand the sample size.

ACKNOWLEDGEMENTS

The authors acknowledge the editorial team's and reviewers' contributions, which strengthened the clarity and consistency of this research paper.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

AUTHORS' CONTRIBUTIONS

Gholam Sakhi-Saes: Conceptualization, Software, Investigation, Resources, Writing - Original Draft Mohammad Kavoosi-Kalashami: Methodology, Formal analysis, Writing - Review & Editing, Visualization, Supervision, Project administration Fatemeh Askari Bozayeh: Validation, Data Curation, Writing - Original Draft and AmirAli Faridi: Software, Investigation.

REFERENCES

Adnan, N., Nordin, S. M., & bin Abu Bakar, Z. (2017). Understanding and facilitating sustainable agricultural practice: A comprehensive analysis of adoption behavior among Malaysian paddy farmers. *Land Use Policy, 68*, 372–382.

Agricultural Organization of Lasht-e-Nesha

district. (2020). *Report on the performance of agricultural jahad of Lasht-e-Nasha in 2019*. http://jahad-ln.blogfa.com/ (Accessed on 2019.12.01.)

Aitken, R., Watkins, L., Williams, J., & Kean, A. (2020). The positive role of labelling on consumers' perceived behavioral control and intention to purchase organic food. *Journal of Cleaner Production, 255*, 120334.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Prentice-Hall.

AL, B. (2002). *Linked: The new science of networks*. Perseus Books Group.

Al-Swidi, A., Huque, S. M. R., Hafeez, M. H., & Shariff, M. N. M. (2014). The role of subjective norms in theory of planned behavior in the context of organic food consumption. *British Food Journal, 116*(10), 1561–1580.

Amsalu, A., & De Graaff, J. (2007). Determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed. *Ecological Economics, 61*(2–3), 294–302.

Andrews, J. E., Ward, H., & Yoon, J. (2021). UTAUT as a model for understanding intention to adopt AI and related technologies among librarians. *The Journal of Academic Librarianship, 47*(6), 102437.

Ankamah, J., Kodua, T. T., & Addae, M. (2021). Structural equation modelling of perception for sustainable agriculture as climate change mitigation strategy in Ghana. *Environmental Systems Research, 10*(1), 1–13.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science, 16*(1), 74–94.

Beedell, J., & Rehman, T. (2000). Using social-psychology models to understand farmers' conservation behaviour. *Journal of Rural Studies, 16*(1), 117–127.

Belachew, A., Mekuria, W., & Nachimuthu, K. (2020). Factors influencing adoption of soil and water conservation practices in the northwest Ethiopian highlands. *International Soil and Water Conservation Research, 8*(1), 80–89.

Bjørkhaug, H., & Blekesaune, A. (2013). Development of organic farming in Norway: A statistical analysis of neighbourhood effects. *Geoforum, 45*, 201–210.

Blazy, J.-M., Carpentier, A., & Thomas, A. (2011). The willingness to adopt agro-ecological innovations: Application of choice modelling to Caribbean banana planters. *Ecological Economics, 72*, 140–150.

Cakirli Akyüz, N., & Theuvsen, L. (2020). The impact of behavioral drivers on adoption of sustainable agricultural practices: The case of organic farming in Turkey. *Sustainability, 12*(17), 6875.

Carne, G., Leconte, S., Sirot, V., Breysse, N., Badot, P.-M., Bispo, A., Deportes, I. Z., Dumat, C., Rivière, G., & Crepet, A. (2021). Mass balance approach to assess the impact of cadmium decrease in mineral phosphate fertilizers on health risk: The case-study of French agricultural soils. *Science of the Total Environment, 760*, 143374.

Chau, P. Y., & Hu, P. J. (2002). Examining a model of information technology acceptance by individual professionals: An exploratory study. *Journal of Management Information Systems, 18*(4), 191–229.

Chin, W. W. (2002). Partial least squares for researchers: An overview and presentation of recent advances using the PLS approach. *ICIS*, 741–742.

Concepción, E. D., Aneva, I., Jay, M., Lukanov, S., Marsden, K., Moreno, G., Oppermann, R., Pardo, A., Piskol, S., Rolo, V., Schraml, A., & Díaz, M. (2020). Optimizing biodiversity gain of European agriculture through regional targeting and adaptive management of conservation tools. *Biological Conservation, 241*, 108384.

Darnhofer, I., Lamine, C., Strauss, A., & Navarrete, M. (2016). The resilience of family farms: Towards a relational approach. *Journal of Rural Studies, 44*, 111–122.

Dasgupta, S., & Gupta, B. (2019). Espoused organizational culture values as antecedents of internet technology adoption in an emerging economy. *Information & Management, 56*(6), 103142.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 319–340.

Davison, A. C., & Hinkley, D. V. (1997). *Bootstrap methods and their application*. Cambridge University Press.

Defrancesco, E., Gatto, P., Runge, F., & Trestini, S. (2008). Factors affecting farmers' participation in agri-environmental measures: A Northern Italian perspective. *Journal of Agricultural Economics, 59*(1), 114–131.

Dessart, F. J., Barreiro-Hurlé, J., & Van Bavel, R. (2019). Behavioural factors affecting the adoption of sustainable farming practices: A policy-oriented review. *European Review of Agricultural Economics, 46*(3), 417–471.

Diekmann, M., & Theuvsen, L. (2019). Non-participants interest in CSA – Insights from Germany. *Journal of Rural Studies, 69*, 1–10.

Dunlap, R., Liere, K. V., Mertig, A., & Jones, R. E. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues, 56*(3), 425–442.

Emery, S. B., & Franks, J. R. (2012). The potential for collaborative agri-environment schemes in England: Can a well-designed collaborative approach address farmers' concerns with current schemes? *Journal of Rural Studies, 28*(3), 218–231.

European Commission website. (2021). https://ec.europa.eu/info/index_en. Accessed on October 8, 2021.

Fahad, S., Saud, S., Akhter, A., Bajwa, A. A., Hassan, S., Battaglia, M., Adnan, M., Wahid, F., Datta, R., Babur, E., Danish, S., Zarei, T., & Irshad, I. (2021). Bio-based integrated pest management in rice: An agro-ecosystems friendly approach for agricultural sustainability. *Journal of the Saudi Society of Agricultural Sciences, 20*(2), 94–102. https://doi.org/10.1016/j.jssas.2020.12.004

Faridi, A. A., Kavoosi-Kalashami, M., & El Bilali, H. (2020). Attitude components affecting adoption of soil and water conservation measures by paddy farmers in Rasht County, Northern Iran. *Land Use Policy, 99*, 104885.

Faridi, A. A., Kavoosi-Kalashami, M., & El Bilali, H. (2021). Comprehensive modeling of affecting factors on the adoption of conservation practices among paddy farmers in North of Iran. *Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development, 21*(1), 281-294.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Addison-Wesley.

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behaviour: The reasoned action approach*. Taylor & Francis Group.

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: Integrating resilience, adaptability, and transformability. *Ecology and Society, 15*(4), 1-9.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*, 39–50. https://doi.org/10.2307/3151312

Friedlander, L., Tal, A., & Lazarovitch, N. (2013). Technical considerations affecting adoption of drip irrigation in sub-Saharan Africa. *Agricultural Water Management, 126*, 125–132.

Getz, C., & Shreck, A. (2006). What organic and Fair-Trade labels do not tell us: Towards a place-based understanding of certification. *International Journal of Consumer Studies, 30*(5), 490–501.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed, a silver bullet. *Journal of Marketing Theory & Practice, 19*(2), 139–152. https://doi.org/10.2753/MTP1069-6679190202

He, K., Zhang, J., & Zeng, Y. (2020). Households' willingness to pay for energy utilization of crop straw in rural China: Based on an improved UTAUT model. *Energy Policy, 140*, 111373.

Heyder, M., Theuvsen, L., & Hollmann-Hespos, T. (2012). Investments in tracking and tracing systems in the food industry: A PLS analysis. *Food Policy, 37*(1), 102–113.

Holling, C. S., & Gunderson, L. H. (2002). Resilience and adaptive cycles. In *Panarchy: Understanding transformations in human and natural systems* (pp. 25–62). https://hdl.handle.net/10919/67621

Home, R., Balmer, O., Jahrl, I., Stolze, M., & Pfiffner, L. (2014). Motivations for implementation of ecological compensation areas on Swiss lowland farms. *Journal of Rural Studies, 34*, 26–36.

Hu, H., & Xiong, L. (2014). Genetic engineering and breeding of drought-resistant crops. *Annual Review of Plant Biology, 65*, 715–741.

Jia, L., Zhao, W., Zhai, R., Liu, Y., Kang, M., & Zhang, X. (2019). Regional differences in the soil and water conservation efficiency of conservation tillage in China. *Catena, 175*, 18–26.

Jiang, L., Wang, Y., He, L., Sun, Z., Liu, Y., & Bu, J. (2021). Ecological benefit analysis of restoration of degraded environment by artificial Tamarix-Cistanche. *Environmental Technology & Innovation, 23*, 101792.

Jihad Agriculture Organization of Guilan Province. (2020). Rice production report. Rice room.

Kassie, M., Teklewold, H., Jaleta, M., Marenya, P., & Erenstein, O. (2015). Understanding the adoption of a portfolio of sustainable intensification practices in eastern and southern Africa. *Land Use Policy, 42*, 400–411.

Kijsanayotin, B., Pannarunothai, S., & Speedie, S. M. (2009). Factors influencing health information technology adoption in Thailand's community health centers: Applying the UTAUT model. *International Journal of Medical Informatics, 78*(6), 404–416.

Kpadonou, R. A. B., Owiyo, T., Barbier, B., Denton, F., Rutabingwa, F., & Kiema, A. (2017). Advancing climate-smart-agriculture in developing drylands: Joint analysis of the adoption of multiple on-farm soil and water conservation technologies in West African Sahel. *Land Use Policy, 61*, 196–207.

Läpple, D. (2010). Adoption and abandonment of organic farming: An empirical investigation of the Irish drystock sector. *Journal of Agricultural Economics, 61*(3), 697–714.

Li, M., Fu, Q., Singh, V. P., Liu, D., Li, T., & Li, J. (2020). Sustainable management of land, water, and fertilizer for rice production considering footprint family assessment in a random environment. *Journal of Cleaner Production, 258*, 120785.

Lili, D., Ying, Y., Qiuhui, H., & Mengxi, L. (2021). Residents' acceptance of using desalinated water in China based on the theory of planned behaviour (TPB). *Marine Policy, 123*, 104293.

Ma, S., Swinton, S. M., Lupi, F., & Jolejole-Foreman, C. (2012). Farmers' willingness to participate in Payment-for-Environmental-Services programmes. *Journal of Agricultural Economics, 63*(3), 604–626.

Magruder, J. R. (2018). An assessment of experimental evidence on agricultural technology adoption in developing countries. *Annual Review of Resource Economics, 10*, 299–316.

Mahmoudi, A., Abbasi, M., & Deng, X. (2021). Robust project portfolio selection towards organizational resilience: Post-COVID perspective. *Expert Systems with Applications*, 116067.

Maraseni, T. N., Deo, R. C., Qu, J., Gentle, P., & Neupane, P. R. (2018). An international comparison of rice consumption behaviours and greenhouse gas emissions from rice production. *Journal of Cleaner Production, 172*, 2288–2300.

Miller, K. (2005). *Communications theories: Perspectives, processes, and context* (pp. 126–128). McGraw-Hill.

Motevali, A., Hashemi, S. J., & Tabatabaeekoloor, R. (2019). Environmental footprint study of white rice production chain: Case study of Northern Iran. *Journal of Environmental Management, 241*, 305–318.

Mozzato, D., Gatto, P., Defrancesco, E., Bortolini, L., Pirotti, F., Pisani, E., & Sartori, L. (2018). The role of factors affecting the adoption of environmentally friendly farming practices: Can geographical context and time explain the differences

emerging from literature? *Sustainability, 10*(9), 3101.

Mustafa, G., Mahmood, H., & Iqbal, A. (2021). Environmentally friendly farming and yield of wheat crop: A case of developing country. *Journal of Cleaner Production, 314*, 127978.

Mutyasira, V., Hoag, D., & Pendell, D. (2018). The adoption of sustainable agricultural practices by smallholder farmers in Ethiopian highlands: An integrative approach. *Cogent Food & Agriculture, 4*(1), 1552439.

Wang, N., Gao, Y., Wang, Y., & Li, X. (2016). Adoption of eco-friendly soil management practices by smallholder farmers in Shandong Province of China. *Journal of Soil Science and Plant Nutrition*, 62(2), 185-193.

Nebel, S., Schneider, S., Schledjewski, J., & Rey, G. D. (2017). Goal-setting in educational video games: Comparing goal-setting theory and the goal-free effect. *Simulation & Gaming, 48*(1), 98–130.

Niyaki, A., Radjabi, R., & Allahyari, M. S. (2010). Social factors critical for adoption of biological control agents *Trichogramma* spp. egg parasitoid of rice stem borer *Chilo suppressalis* in North of Iran. *American-Eurasian Journal of Agricultural & Environmental Sciences, 9*(2), 133–139.

Nyanga, P. H. (2012). Factors influencing adoption and area under conservation agriculture: A mixed methods approach. *Sustainable Agriculture Research, 1*(526-2016–37812).

Olazabal, M. (2017). Resilience, sustainability and transformability of cities as complex adaptive systems. In *Urban Regions Now & Tomorrow* (pp. 73–97). Springer.

Oliveira, T., Faria, M., Thomas, M. A., & Popovič, A. (2014). Extending the understanding of mobile banking adoption: When UTAUT meets TTF and ITM. *International Journal of Information Management, 34*(5), 689–703.

Padel, S., & Foster, C. (2005). Exploring the gap between attitudes and behaviour: Understanding why consumers buy or do not buy organic food. *British Food Journal, 107*(8), 606–625.

Park, H. S. (2000). Relationships among attitudes and subjective norms: Testing the theory of reasoned action across cultures. *Communication Studies, 51*(2), 162–175.

Pascucci, S., de-Magistris, T., Dries, L., Adinolfi, F., & Capitanio, F. (2013). Participation of Italian farmers in rural development policy. *European Review of Agricultural Economics, 40*(4), 605–631.

Pei, Y., Wang, S., Fan, J., & Zhang, M. (2015). An empirical study on the impact of perceived benefit, risk and trust on e-payment adoption: Comparing quick pay and union pay in China. In *2015 7th International Conference on Intelligent Human-Machine Systems and Cybernetics* (Vol. 2, pp. 198–202).

Price, J. C., & Leviston, Z. (2014). Predicting pro-environmental agricultural practices: The social, psychological and contextual influences on land management. *Journal of Rural Studies, 34*, 65–78.

Rivera, M., Shapoval, V., & Medeiros, M. (2021). The relationship between career adaptability, hope, resilience, and life satisfaction for hospitality students in times of COVID-19. *Journal of Hospitality, Leisure, Sport & Tourism Education, 29*, 100344.

Roberts, F., Archer, F., & Spencer, C. (2021). The potential role of nonprofit organisations in building community resilience to disasters in the context of Victoria, Australia. *International Journal of Disaster Risk Reduction, 65*, 102530.

Roos, D., Saldaña, C. C., Arroyo, B., Mougeot, F., Luque-Larena, J. J., & Lambin, X. (2019). Unintentional effects of environmentally-friendly farming practices: Arising conflicts between zero-tillage and a crop pest, the common vole (*Microtus arvalis*). *Agriculture, Ecosystems & Environment, 272*, 105–113.

Saber, Z., van Zelm, R., Pirdashti, H., Schipper, A. M., Esmaeili, M., Motevali, A., Nabavi-Pelesaraei, A., & Huijbregts, M. A. J. (2021). Understanding farm-level differences in environmental impact and eco-efficiency: The case of rice production in Iran. *Sustainable Production and Consumption, 27*, 1021–1029.

Sapkota, T. B., Jat, M. L., Aryal, J. P., Jat, R. K., & Khatri-Chhetri, A. (2015). Climate change adaptation, greenhouse gas mitigation and economic profitability of conservation agriculture: Some examples from cereal systems of Indo-Gangetic Plains. *Journal of Integrative Agriculture, 14*(8), 1524–1533.

Sarstedt, M. (2008). A review of recent approaches for capturing heterogeneity in partial least squares path modelling. *Journal of Modelling in Management*, *3(2)*,140-161.

Shahane, A. A., Shivay, Y. S., Prasanna, R., & Kumar, D. (2019). Improving water and nutrient use efficiency in rice by changing crop establishment methods, application of microbial inoculations, and Zn fertilization. *Global Challenges, 3*(10), 1800005.

Smith, P., Bustamante, M., Ahammad, H., Clark, H., Dong, H., Elsiddig, E. A., Haberl, H., Harper, R., House, J., & Jafari, M. (2014). Climate change 2014: Mitigation of climate change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. In O. Edenhofer, R. Pichs-Madruga, & Y. Sokona (Eds.), *Forestry and Other Land Use* (pp. 811–922). Cambridge University Press.

Soper, D. S. (2021). *A-Priori Sample Size Calculator for Structural Equation Models* (Version 4.0) [Computer software]. Available from https://www.danielsoper.com/statcalc/calculator.aspx?id=89.

Tadesse, M., & Belay, K. (2004). Factors influencing adoption of soil conservation measures in southern Ethiopia: The case of Gununo area. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS), 105*(1), 49–62.

Tagg, A. S., Brandes, E., Fischer, F., Fischer, D., Brandt, J., & Labrenz, M. (2021). Agricultural application of microplastic-rich sewage sludge leads to further uncontrolled contamination. *Science of the Total Environment*, 150611.

Teklewold, H., Kassie, M., & Shiferaw, B. (2013). Adoption of multiple sustainable agricultural practices in rural Ethiopia. *Journal of Agricultural Economics, 64*(3), 597–623.

The American Farm Bureau website. (2021). https://www.fb.org/. Accessed on October 8, 2021.

Tilman, D., & Clark, M. (2014). Global diets link environmental sustainability and human health. *Nature, 515*(7528), 518–522.

Tittonell, P. (2014). Livelihood strategies, resilience and transformability in African agroecosystems. *Agricultural Systems, 126*, 3–14.

U.S. Department of Agriculture website. (2021). https://www.nal.usda.gov/main/. Accessed on October 8, 2021.

Ugulu, I., Akhter, P., Khan, Z. I., Akhtar, M., & Ahmad, K. (2021). Trace metal accumulation in pepper (*Capsicum annuum* L.) grown using organic fertilizers and health risk assessment from consumption. *Food Research International, 140*, 109992.

Upadhyay, B. M., Young, D. L., Wang, H. H., & Wandschneider, P. (2003). How do farmers who adopt multiple conservation practices differ from their neighbors? *American Journal of Alternative Agriculture, 18*(1), 27–36.

United States Department of Agriculture. (2019). Grain: World markets and trade. Foreign Agricultural Service.

Vanslembrouck, I., Van Huylenbroeck, G., & Verbeke, W. (2002). Determinants of the willingness of Belgian farmers to participate in agri-environmental measures. *Journal of Agricultural Economics, 53*(3), 489–511.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186–204.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425–478.

Vinzi, V. E., Trinchera, L., & Amato, S. (2010). PLS path modeling: From foundations to recent developments and open issues for model assessment and improvement. In

Handbook of partial least squares (pp. 47–82).
Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society, 9*(2), 1-9.
Westland, J. C. (2010). Lower bounds on sample size in structural equation modeling. *Electronic Commerce Research and Applications, 9*(6), 476-487.
Wilson, G. A., & Hart, K. (2000). Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. *Environment and Planning A, 32*(12), 2161–2185.
Wollni, M., & Andersson, C. (2014). Spatial patterns of organic agriculture adoption: Evidence from Honduras. *Ecological Economics, 97*, 120–128.
Yadav, R., & Pathak, G. S. (2016a). Intention to purchase organic food among young consumers: Evidence from a developing nation. *Appetite, 96*, 122–128.
Yadav, R., & Pathak, G. S. (2016b). Young consumers' intention towards buying green products in a developing nation: Extending the theory of planned behavior. *Journal of Cleaner Production, 135*, 732–739.
Yao, Z., Zheng, X., Liu, C., Lin, S., Zuo, Q., & Butterbach-Bahl, K. (2017). Improving rice production sustainability by reducing water demand and greenhouse gas emissions with biodegradable films. *Scientific Reports, 7*(1), 1–10.
Yiridoe, E. K., Atari, D. O. A., Gordon, R., & Smale, S. (2010). Factors influencing participation in the Nova Scotia environmental farm plan program. *Land Use Policy, 27*(4), 1097–1106.

How to cite this article:
Sakhi-Saes, G. ., Kavoosi, M., AskaryBozayeh, F. ., & Faridi, A. (2024). Investigating factors affecting the adoption of environmentally friendly agricultural practices in paddy farms of Iran. *International Journal of Agricultural Management and Development, 14*(4), 341-359.
DOI: 10.71877/ijamad.2024.8277