INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 12, Issue 10, (2022) E-ISSN: 2222-6990

The Relationship between Knowledge, Attitude, and Practice toward Organic Fertilizer Adoption among Almond Smallholder Farmers in Uruzgan, Afghanistan

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To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v12-i10/15108 DOI:10.6007/IJARBSS/v12-i10/15108

Published Date: *29* October 2022

Abstract

Almonds are an important dried fruit and second in the ranking, after raisin and grape, in Afghanistan. The decline in their production is due to low levels of technology adoption, as well as the extreme use and poor timing of inorganic fertilizer application in the Uruzgan Province. Since organic fertilizers are vital to producing quality almonds, this study examined the relationship between the knowledge, attitude, and practice related to the adoption of organic fertilizer. This study applied the technology acceptance model (TAM) and theory of planned behaviour (TPB) to investigate the adoption of organic fertilizer. The Tarin Kowt District was purposively selected, as it represents the top almond-producing district of Uruzgan Province. A multi-stage sampling survey was employed with 116 almond smallholder farmers. The results show a positive and significant effect of practice and knowledge on organic fertilizer adoption. To improve organic fertilizer adoption, knowledge and practice should be advocated among almond smallholder farmers. This research contributes to the demonstration of practical training methods and participation in technology, as training is the most important factor in providing information about organic fertilizer adoption and could have a higher chance of stimulating farmers to adopt organic fertilizers.

Keywords: Knowledge, Attitude, Practice (KAP), Organic Fertilizer Adoption, Almond

Introduction

Afghanistan is a mountainous, poor, landlocked, largely rural country, with about 85% of the population living in the countryside in scattered hamlets and villages (Ward et al., 2008). Rural areas are home to more than 80% of the population, and nearly 90% are vulnerable, with agriculture playing an important role in their livelihoods (Ward et al., 2008; World Bank, 2014). On the other hand, agriculture is the second-largest economic pillar after the services industry in Afghanistan, accounting for about 25% of the country's gross domestic product GDP. Around 40% of the country's workforce is employed in agriculture, which supports about 80% of the country's economy (World Bank, 2017). It remains an important sector, as a source of livelihood for the rural poor, influencing the affordability of basic food items for the population, and it provides significant inputs into the manufacturing sector (World Bank, 2018).

Afghanistan's varied geographical and climatic environments allow it to produce a wide variety of crops at various times of the year. Grapes, almonds, and pomegranates are the most important commodities, with the majority of them being exported (World Bank, 2014). In addition, increased productivity in the agricultural sector is fundamental to meeting domestic demand. Significant approaches such as improvements in irrigation facilities, better access to high-quality inputs, and better access to technology could prompt agricultural productivity in the short–medium term to help farmers and increase yields and productivity (World Bank, 2018). However, most of the supplied inputs are of low quality (fertilizers, seeds, pesticides, etc.), resulting in lower yields and productivity. This is caused by the absence of an effective regulatory system in the country that would enforce seed certification and fertilizer application, control banned pesticides, constantly monitor domestic supplies, and prevent low-quality imports and hazardous agricultural inputs (World Bank, 2017).

In Uruzgan, horticultural crops, especially almonds, are badly affected by disease pests and low-yielding technologies (USAID, 2016). The organic (animal manure) and inorganic fertilizer rate and time of application vary widely in Uruzgan and the country at large. Late and early applications of fertilizers are due to the lack of knowledge of smallholder farmers (Madden & Bell, 2012). Smallholder farmers are thus disadvantaged in their access to extension services and productive investments, and they lack resources to take advantage of new productive technologies (MoHE, 2013). Generally, small-scale farmers dominate the agricultural sector, with 75% of farmers owning one jerib (one-fifth of a hectare) or less. Only around 16% of the farms have more than 10 hectares of irrigated or rain-fed arable land, and only 6.5% of these farms have more than 20 hectares, covering roughly 33% of the irrigated and 50% of the rain-fed area. In addition, farming does not provide enough food for most farm families, and just a few farms provide a viable product (USAID, 2016; Ward et al., 2008; World Bank, 2017).

In fact, the farmers may know the benefits of organic fertilizer, but the greatest problem regarding farmers is their attitude toward conversion (Janjhua et al., 2019). Thus, farmers feel that soil productivity is declining, the tastes of the foods are worsening, and soil microorganism levels are decreasing; thus, they possess a positive attitude toward organic fertilizers (Islam & Islam, 2020). The farmers often believe that using organic fertilizers is the right way to protect the soil (Janjhua et al., 2019). Furthermore, smallholder farmers rely on traditional farming practices and produce mostly for their family’s needs. Hence, farmers engaged in traditional agriculture do not have a lot of access to products and input markets. Khaledi et al (2010) pointed out that smallholder farms are suitable for operation with organic fertilizer, while large farms are more difficult to manage under organic fertilizer.

In addition, organic fertilizers are carbon-based substances that help plants grow more productively and with better quality. Growers apply organic fertilizers for the sake of their various advantages over chemical fertilizers, which include ensuring the food produced is free of hazardous chemicals, their significantly lower price than chemical fertilizers, their ability to keep the farmland productive for hundreds of years, and their non-polluting nature, as they are quickly biodegraded (Organic Facts, 2020). Nutrients from organic fertilizers are released gradually and regularly, avoiding the potential boom-and-bust cycle. This also enhances the soil's organic content, improves the structure, and reduces topsoil erosion, while being comparatively less expensive (Fairhurst, 2012).

Farmers are usually not organized in self-help organizations or cooperatives; therefore, agricultural production is dispersed. Furthermore, agro-processing industries are underdeveloped, more than 80% of farmers have little or no access to agricultural extension support, rural infrastructure is lacking, rural financial services are lacking, modes of transportation are insufficient, institutional arrangements are lacking, standardization and quality control services are insufficient, and agricultural support policy is ineffective (USAID, 2016). In the context of sustainable almond production, on-time fertilizer application and environmental sustainability may require reducing the amount of fertilizer used or simply using chemical fertilizers. The organic fertilizer adopted should, therefore, focus on increasing the yield, improving sustainable growth and development, and expanding the innovative agricultural inputs, which will enable sufficient production.

Therefore, in this study, both the theory of acceptance model (TAM) by Davis (1989) and the theory of planned behaviour (TPB) by Ajzen (1991) were utilized as a theoretical framework to better understand the factors that influence farmers' behavioural intentions as regards organic fertilizer adoption. Due to the unique characteristics of both organic fertilizers and almond farmers, the research model was developed according to TAM and TPB while considering the three factors of knowledge, attitude, and practice in the context of organic fertilizer adoption.

For all these important reasons, the knowledge, attitude, and practice (KAP) study in the Tarin Kowt District of Uruzgan Province must be assessed alongside the relationship with the adoption of organic fertilizer. The problem of this study focuses on assessing knowledge, attitude, and practice toward organic fertilizer adoption among smallholder farmers in Tarin Kowt district of Uruzgan, Afghanistan. The research seeks to address the challenges in organic fertilizer adoption and answers the following questions:

- Is there any correlation between knowledge, attitude, and practice toward the adoption of organic fertilizer in Uruzgan, Afghanistan?
- What are the impacts of knowledge, attitude, and practice (KAP) on organic fertilizer adoption in Uruzgan, Afghanistan?

Literature Review and Hypotheses Development

Various studies using the theory of planned behaviour, theory of reasoned action, and theory of acceptance model have focused on the effect of psychological variables on individual behaviour (Kamrath et al*.,* 2018). Numerous researchers have studied the relationship between attitude, farming practices, and other psychological factors in agriculture (Chuang et al*.,* 2020). TPB, which is an extension of TRA (Cheung & Chan, 2000), and TAM, which is extended by TPB (Sok et al., 2020), have been widely used and tested in a variety of sectors. For instance, both TAM and TPB are used in ICT technology (Amin et al., 2014), artificial intelligence in agriculture (Mohr & Kuhl, 2021), e-learning among students (Al-Emran & Teo, 2020). The theories of TPB and TAM describe the relationship between multiple beliefs and attitudes that affect behaviour.

This study investigated the relationship between organic fertilizer adoption and related knowledge, attitude, and practice. Therefore, this study employed a comprehensive knowledge, attitude, and practice (KAP) model based on the previous literature for further investigation.

Knowledge, Attitude, and Practice toward Organic Fertilizer Adoption (KAP)

The KAP model measures three significant pillars: knowledge, attitude, and practice. A KAP research is crucial for a given group of researchers to gather data on what people know, believe, and accomplish regarding a certain topic (Kaliyaperuma, 2004; WHO, 2008). Knowledge, attitude, and practice (KAP) models studying the uptake of innovations have been carried out since the 1980s (Meijer et al., 2015). Although the model is originated from medical research, it has also been adopted in other fields. For instance, Ahmad et al. (2020) used the KAP model to determine the adoption of green fashion innovation. Mostafavi et al. (2014) used this model to analyse public perceptions of innovative financing for infrastructure systems. Gadzekpo et al (2018) used the KAP model for climate change reporting among Ghanaian journalists. Azanaw et al (2021) used this model to analyse the food safety of college students in Ethiopia, while Oremo et al (2019) used this model in water resources management among smallholder irrigators in Kenya.

A KAP study can be conducted at any time throughout farming activities; however, it is most useful in the early phase of agricultural practices to determine new approaches and interventions to address any potential constraints (seeds, pesticides technology, etc.). Then, the data from the KAP study can be used to allocate resources, design a project, and establish a model for comparison, as well as a post-intervention KAP survey (Jan et al., 2011). However, based on the KAP model, farmers must be aware of the technology before applying it. This is because understanding the level of knowledge, attitude, and practice (KAP) will lead to a more efficient method of creating awareness by allowing the program to be adapted more effectively according to the community's requirements (Kaliyaperuma, 2004). Therefore, understanding this model in the present study may provide insight into the relationship between knowledge, attitude, and practice toward the adoption of organic fertilizers.

Organic Fertilizer Adoption

Organic fertilizer has been used as a source of plant nutrients and soil amendment in many agricultural systems (Javier, 2019). Fertilizers made from organic materials, such as manures and composts, are other alternatives for preserving almond tree nutrition. Organic matter improves drainage in heavy soils, increases water retention capacity in sandy soils, and boosts soil organism activity. Soil organisms also promote soil fertility and generate pores, which help maintain a good soil structure. Before planting the trees, cover crops such as annual hay grasses, cereal, and legume crops can be placed along the tree lines to enhance soil organic matter (Wilkinson, 2005). The application of organic matter around the root zone to improve the diversity of microorganisms in the soil has been proven to treat root and crown rot disease.

Indeed, a few related studies conducted on organic fertilizers in almond production have recommended different views. A study conducted by Sanchez-Bel et al (2008); Perez-Murcia et al (2021) who found that the almonds cultivated under organic fertilizer were with higher contents of sugar, organic acids, fiber, thicker kernels and similar fat content, compared with almonds treated with inorganic fertilizers. Furthermore, even under the same conditions, organic fertilizers produced better results than mineral fertilizers. As a matter of fact, organically cultivated produce is preferred by consumers due to the health benefits and environmental friendliness of the agronomic method.

Given the importance of organic fertilizers, as discussed above, the adoption of organic fertilizers is a lengthy process. According to Khaledi et al (2010), the decisions to adopt organic fertilizer practices involve three stages. The first stage requires farmers to learn about organic fertilizer; then, potential adopters need to pursue information about the technology by accessing public information or asking individuals who are educated about it. The third stage involves producers evaluating the costs and advantages of technology in comparison with its alternatives. If a farmer believes that organic agriculture ranks better than the alternative after weighing the expected costs and advantages of the two options, then he/she will proceed to the adoption stage.

The importance of knowledge has been emphasized in several studies that examine the process of converting to organic fertilizers. For instance, Khaledi et al. (2010) identified that knowledge about organic fertilizer is critical in the adoption process. Thus, a farmer’s decision to switch to organic fertilizer necessitates him/her to be aware of organic farming prior to making the adoption. Sapbamrer and Thammachai (2021) highlighted the practices of organic fertilizers had an influence on their adoption. According to Padel et al (2009), farmers’ social norms and attitudes are likely to be the driver of choice criteria.

Knowledge toward Organic Fertilizer Adoption

The first phase of the KAP model is knowledge. The rising importance of knowledge in institutions and its impact on all levels of an institution characterizes the 21st century. Furthermore, knowledge is a valuable tool in the innovation process in all domains (Bose, 2004). Knowledge is defined as information that leads to comprehension and the capacity to make well-informed decisions (Badran, 1995).

The knowledge gap is a critical issue as regards the usage of organic fertilizers by farmers in agriculture. One of the main causes is farmers’ lack of information about how to utilize fertilizers efficiently (Huang et al., 2015). Government institutions should produce technical guides that take into consideration both international standards and local situations to bridge the gap of knowledge and information. These guides are intended for farmers, as well as for other stakeholders such as organic fertilizer manufacturers, agricultural consultants, etc. (Chen et al., 2020). Directly approaching farmers in the field to disseminate knowledge and demonstrate organic fertilizer application is a powerful strategy to enhance farmers' understanding of the benefits of organic fertilizers (Huang et al., 2015).

Organic fertilizer-related knowledge and its influence on soil productivity have become significant issues, as farmers' knowledge is crucial for studying organic fertilizers (Blanchard et al., 2013). Researches by Azman et al (2013); Ahmad et al (2017) revealed the positive relationship between contract farmers' knowledge and the adoption of sustainable agriculture techniques. Therefore, knowledge is one of the most important factors in the recognition of sustainable agriculture; it is crucial in terms of implementation and has the potential to improve sustainable practices.

According to the findings of Laor et al (2018), knowledge has a significant impact on municipal solid waste management. The finding of Kassie et al (2009) showed that knowledge and communication skills are vital in the adoption of organic fertilizers. This leads to the development of the first hypothesis of this study based on this literature.
Hypothesis 1 (H1). There is a statistically significant impact of knowledge on organic fertilizer adoption.

Attitude toward Organic Fertilizer Adoption

Attitude is a general assessment of how much a person likes or dislikes a certain object, topic, person, or activity. The attitudes also reflect how a person feels about something based on the network of relationships related to it and opinions on companies, product categories, advertisements, individuals, places, activities, etc. (Hoyer et al., 2010). Additionally, attitude is defined as a mental and neutral state of readiness that is organized by experience and exerts a directional or dynamic impact on an individual's behaviour to all objects and situations, which is often related to (Banaji & Heiphetz, 2010; Chaiklin, 2011).

Indeed, attitude is critical if agricultural farmers believe that the adoption of innovation would be beneficial to the group or community (Banaji & Heiphetz, 2010). Additionally, there are many relevant studies on the attitude of farmers toward the adoption of technologies that have proposed various perspectives.

The way a person feels about organic fertilizers is shaped by how he/she evaluates a situation. Attitude is an important factor that motivates people to undertake tasks such as applying organic fertilizer (Islam & Islam, 2020) and a significant correlation between attitude and acceptance (Azman et al., 2013). Farmers' response on attitude toward organic fertilizers helps to understand their actual mental affiliation with organic fertilizers (Das et al., 2019). A favourable attitude will lead to a shift in behaviour, that is, the implementation of organic fertilizers and the adoption of organic fertilizers is largely influenced by one's attitude (Herath & Wijekoon, 2013). The second hypothesis of this study is established based on this literature.
Hypothesis 2 (H2). There is a significant and positive relationship between attitude and organic fertilizer adoption.

Practice toward Organic Fertilizer Adoption

Practice is the last part of the KAP model, in which the practice is defined as a mixture of knowledge and attitude that work together (Badran, 1995). Practice refers to how an individual demonstrates knowledge and attitude through actions (Kaliyaperuma, 2004). It is also referred to as the production method or strategies used to produce the insured crop, allowing it to mature normally and provide at least the yield that determines guaranteed production (USDA, 2014). However, as far as agricultural practices are concerned, and in today's global marketplace with industrial, financial, or service industries, businesses rely on continuous advancements that result in changes in practice in order to remain viable in a competitive environment (Stategic Direction, 2007).

As a result, practice is dependent on the farmers' economic stability and socio-financial situation. Indeed, practice is a matter of understanding what was planned (Hassan et al., 2019). According to the findings of Kazeem et al (2017), farmers demonstrated a higher level of adoption of innovation as a result of the practical demonstrations provided during the training. Other relevant studies on farmers' practice of technology adoption offer different perspectives. For instance, Ahmad et al (2020) found that practice has no statistically significant impact on green fashion adoption; Laor et al (2018) found that knowledge has a significant effect and positive correlation with practices and further stated that respondents have good practice toward municipal waste management. The third hypothesis of this study was established based on this literature.
Hypothesis 3 (H3). *There is a statistically significant impact of practice on organic fertilizer adoption.*

Research Model
This study described the influence of knowledge, attitude, and practice (KAP) on the adoption of organic fertilizers. The model of this study was established based on the previous works, notably (Ahmad et al., 2020; Mostafavi et al., 2014; Azanaw et al., 2021; Aydin, 2019). According to Gumucio (2011), the KAP study shows characteristics in knowledge, attitude, and practice, as well as the conception each person has on the subject matter. It has the potential to enhance knowledge, attitudes, and practices in a way that identifies what is known and accomplished about different subjects (Gumucio, 2011).
The knowledge of organic fertilizers and their impact on soil productivity has become a critical issue today. Therefore, farmers' knowledge of organic fertilizers is essential for studying organic fertilizers (Blanchard et al., 2013). A study conducted by (Aydin, 2019) is based on the KAP model to understand the public opinion about drones. However, The KAP model identifies the most successful ways of spreading information and knowledge from scientific studies and policies (Caribbean Institute of Media & Communication, 2012). A KAP survey is population-based research that gathers information on what is known, believed, and accomplished in connection to a certain topic (Caribbean Institute of Media & Communication, 2012). KAP studies are also effective in generating baseline variables that may be used to analyze intervention impacts, making them an important part of study design and evaluation.

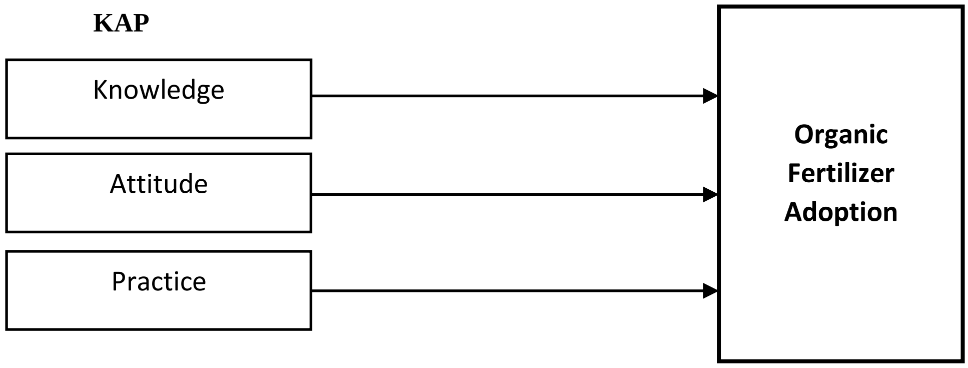

Figure 1: Model source: developed based on studies by (Ahmad et al., 2020; Bano et al., 2013).

Material and Methods

Research Design

A quantitative approach was adopted to attain a deeper understanding of the relationship between knowledge, attitude, and practice toward organic fertilizer adoption among almond smallholder farmers.

Research Population

This study was conducted in one of the districts in Uruzgan Province, southern Afghanistan—namely, Tarin Kowt District. Agriculture is the main activity in the study area. The elevation of the Uruzgan Province from the sea level is around 1350 m, and the climate is relatively hot. Uruzgan Province has a population of 420,964, while Tarin Kowt District has a population of 112,283 (Department of Agriculture, 2019). The population distribution in Tarin Kowt is largely determined by water availability and infrastructure, and there are around 148 villages. Thus, human settlements are largely concentrated in the city of Tarin Kowt, and fewer villages are located outside the city (Department of Agriculture, 2019). The Tarin Kowt District has vast agricultural lands, and major fruit crops grown in the area include almonds, apricots, pomegranate, fig, etc. Most of the farmers in the study area produce a high volume of almonds.

Data Collection

Data collection was undertaken in the Tarin Kowt District. A multi-stage sampling method was used to select an appropriate sample size for the study. In the first stage, the Tarin Kowt District was purposively selected. In the second stage, five villages in this district were purposively selected—namely, Surshikhli, Towri, Sapidkhak, Shawali Kariz, and Chulanger, due to the high production of almonds in these areas. In the last stage, a registered list of 164 almond smallholder farmers was obtained from the Department of Agriculture, and systematic sampling was applied. The Yamane equation was used to calculate the appropriate sample size (Yamane, 1967). At 95% of confidence level, the sample size determined for this study was 116 almond smallholder farmers. The survey was conducted via face-to-face interviews with almond smallholder farmers using structured questionnaires.

In this study, knowledge of organic fertilizer adoption issues referred to the farmers' understanding of the principles of organic fertilizers. The participants were required to demonstrate an understanding of organic fertilizers. Attitude toward organic fertilizer adoption was defined as the respondents' attitudes that influence organic fertilizer adoption, for example, "I am satisfied with organic fertilizer". The practice of organic fertilizers included activities on improving soil fertility, producing premium almonds, and those pertaining to lowering the cost in the almond soil fertility process. The responses to organic fertilizer adoption included those related to improving soil productivity for the almond tree, resistance against pest attack, and that the yield of almonds is higher than the use of inorganic fertilizer. The responses on knowledge, attitude, practice, and organic fertilizer adoption were rated on a five-point Likert scale from 1 to 5, where 1 was "Strongly disagree", 2 was "Disagree", 3 was "Undecided", 4 was "Agree", and 5 was "Strongly agree". The supplement contains the survey questionnaire.

Data Analysis

The data were entered into SPSS version 25, cleaned (missing values and significant outliers were removed), and then analysed using descriptive statistics. Correlations of knowledge, attitude, and practice with organic fertilizers were assessed using Pearson's correlation analysis. The multiple linear regression analysis was used to assess the relationship between knowledge, attitude, and practice toward organic fertilizers. The threshold for the statistical significance was set as $p < 0.05$, with 95% confidence intervals.

Reliability

The questionnaire was developed and subsequently determined appropriate for the context of the study after the pilot test. To increase the degree of reliability of the collected data, the researchers relied on as much as possible of prior research to measure the variables of the current study, which demonstrated their reliability. In fact, the research measures were developed based on literature and then launched a pilot survey before the actual survey. The response scale of the study sample was developed according to a 5-point Likert type scale, which reflects how much a responder agrees with the statements in the questionnaire (1 = Strongly disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, and 5 = Strongly agree).

The Cronbach's alpha was used to measure the internal consistency of the variables to ensure that the questionnaire was reliable. It is a tool for data collection that measures the level of internal consistency of the statement's resolution. As shown in Table 1, the value of Cronbach alpha resulting from the reliability test was 0.872. The Cronbach alpha values are generally used to determine the reliability internal consistency of the statements. The rule of thumb for reliability is an alpha value of 0.60, which is considered low, while alpha values in the range of 0.70–0.80 or higher are considered optimal (Singh, 2007).

Table 1.0
Internal consistency coefficients (Cronbach's alpha)

Variables	**Reliability Coefficient**
Knowledge	0.732
Attitude	0.701
Practice	0.832
Organic fertilizer adoption	0.874
Total	0.872

Characteristics of the Study Sample

Table 2 shows the demographic characteristics of the sampled respondents, including gender, age, level of education, experience, membership of cooperative and extension visits. All of the respondents who participated in this study were male. The finding is in line with Pain et al. (2016) who found that it is not customary for females to be interviewed, as it is not culturally permitted. The result revealed that the average age of respondents was (38.77) years old. Interestingly, Maletta and Favre (2002) stated that the average age of Afghan farmers is approximately 47 years old. The logic behind the contradiction regarding the average year of the farmers is that the research coverage involved all the agro-zones of Afghanistan, while this study covered only the Tarin Kowt of Uruzgan Province. The finding further illustrated that more than 40 (43.1%) farmers were illiterate. This suggests that the farmers cannot read and seek appropriate technologies, and the result is consistent with Osei et al (2017), who found that many farmers (38.0%) have no formal education.

In terms of experience, the average experience of all respondents was (16.95) years. This finding indicates that almost all the farmers have sufficient experience in almond fertilization and the production process. The result is in line with Awunyo-Vitor et al (2016), who found that the maize farmers have an average (14.07) years of experience. Finally, the finding of the demographic profile showed that most of the farmers received neither membership of cooperative nor extension services; that is, the farmers had no extension visit from the extension officers. Suvedi et al (2017) found that nearly (87%) of the respondents stated that extension officers neither stayed at the office nor visited farmers and that such services are not widely available in Afghanistan.

Table 2.0
Socio-demographic profile of almond smallholder farmers (n = 116)

Respondents Profile	**Frequency (f)**	**Percentage (%)**	**Mean**
Gender			
Male	116	100.0	
Female	0	0.00	
Age			
19-34	36	31.2	
35-50	67	57.7	38.77
51-67	13	11.4	
Level of Education			
Illiterate	50	43.1	
Primary School	39	33.6	
Secondary School	18	15.5	
High School	2	1.7	
Vocational	5	4.3	
Bachelor	2	1.7	
Experience			
2-17	66	56.9	
18-34	42	36.4	16.95
35-50	8	7	
Membership of cooperative			
Membered	18	15.5	
Not membered	98	84.5	
Extension visits			
Received extension visit	46	39.7	
Not received extension visit	70	60.3	

Results

Mean and Standard Deviation

Table 3 shows the statistical analysis and results, including the descriptive statistics, which are expressed as mean and standard deviations. Table 3 shows the mean and standard deviations of the respondents' answers to the KAP and the organic fertilizer adoption level. The first variable is knowledge, with a mean value of 4.337, followed by practice, with 4.392, both of which are considered as a high rating. Meanwhile, the attitude had a mean value of 3.472, which is the lowest rating among the independent variables. The organic fertilizer adoption (dependent variable) had a mean value of 4.190 and is considered a low rating.

Table 3.0
Mean and standard deviations of independent and dependent variables

Variables	**Mean**	**Standard Deviation**	**Importance**	**Ranks**
Knowledge	4.337	0.445	High	1
Attitude	3.472	0.713	Low	4
Practice	4.392	0.528	High	2
Organic fertilizer adoption	4.190	0.631	Low	3

Correlation Analysis

Table 4 presents the correlation analysis for the present study. The correlation between the different variables of knowledge, attitude, practice toward organic fertilizer adoption was investigated. Significant and positive correlations were observed between two variables—namely, knowledge and practice toward organic fertilizer adoption ($r = 0.520$, $p < 0.05$), ($r = 0.747$, $p < 0.05$), respectively. Contrarily, there was no correlation between attitude toward organic fertilizer adoption ($r = -0.060$), ($p > 0.05$).

Table 4.0
Correlation results (n = 116)

Variables	**1**	**2**	**3**	**4**
Knowledge	1			
Attitude	0.158*	1		
Practice	0.433**	-0.005	1	
Organic fertilizer adoption	0.520**	-0.060	0.747**	1

* Correlation is significant at the 0.05 level (one tailed).
** Correlation is significant at the 0.01 level (one tailed).

Hypothesis Testing

The following are the three general hypotheses of this study:

Hypothesis 1 (H1). There is a statistically significant impact of knowledge on the adoption of organic fertilizers, $\alpha < 0.05$;

Hypothesis 2 (H2). There is a statistically significant impact of attitude on the adoption of organic fertilizers, $\alpha < 0.05$;

Hypothesis 3 (H3). There is a statistically significant impact of practice on the adoption of organic fertilizers, $\alpha < 0.05$.

To test the above research hypothesis the researchers used multiple regression analysis to assess the impact of knowledge, attitude, and practice (KAP) on the adoption of organic fertilizers. The results are shown in Table 5. This statistical technique enables a researcher to analyze the effect of a set of independent variables (predictors) on a dependent (criterion) variable (Donate & Guadamillas, 2015).

The regression model achieved a high degree of fit, as reflected by the R2 and adjusted R2 values 0.615 and 0.605, respectively. It also indicates that 60.5% of the explained variation in organic fertilizer adoption could be accounted for by the KAP model. Only 39.5% of the variation is unaccounted for by these factors. The model explained 61.5% of the variation (the coefficient determination of R2).

Table 5.0
Multiple regression results

Variables	**Standardized beta Value**	**t-value**	**Significant**	**tolerance**	**VIF**
Constant		-1.047	0.298		
Knowledge	0.262	3.960	0.000	0.787	1.271
Attitude	-0.098	-1.641	0.104	0.968	1.033
Practice	0.633	9.698	0.000	0.807	1.239
R2	0.615				
Adjusted R2=	0.605				
SE estimate	0.39725				
Durbin Watson=	1.814				

Dependent variable: adoption of organic fertilizers.

There were three main independent variables (KAP) tested against organic fertilizer adoption. The standardized coefficient beta values for knowledge, attitude, and practice were 0.262, −0.098, and 0.633, respectively. As mentioned earlier, regression analysis was used to determine the most influential factor that affects the adoption of organic fertilizers. Hence, the beta value was used as the benchmark to decide which factor was the better determinant in this model. Two factors (knowledge and practice) were significant, at a 5% level of significance, as $p < 0.05$, and highly significant (Pallant, 2016). The research accepted the alternative hypothesis and rejected the null hypotheses. In contrast, the attitude variable had no statistically significant impact. The research accepted the null hypothesis and rejected the alternative hypothesis. From Table 5, the practice of organic fertilizers had the highest beta value; hence, it can be concluded that the most influential factor in this study is practice (0.63), followed by the knowledge of organic fertilizers (0.26).

The results suggest that adopting a good organic fertilizer practice to maintain the soil fertility of almond trees contributes the most to predicting organic fertilizer adoption. Possessing a high level of knowledge on organic fertilizers also contributes to this prediction of organic fertilizer adoption.

Discussion

Knowledge, Attitude, and Organic Fertilizer Adoption

The results for the correlation analysis showed that there is a significant correlation between knowledge and organic fertilizer adoption. Knowledge paves the way for farmers to understand better the concept of organic fertilizers. This implies farmers who had adequate knowledge about organic fertilizers were more likely to have more positive attitudes toward them. Shams and Fard (2017) also found that knowledge has a significant correlation with organic farming adoption. The finding is also consistent with the work of Azman et al. (2013), in which they found a positive correlation between knowledge and the adoption of sustainable agriculture practices. Their results showed a positive and significant correlation between practice and organic fertilizer adoption. Farmers with good knowledge are capable of understanding the concepts and, hence, adopt good agricultural practices. The results of the study also concur with Donate and Guadamillas (2015), who found that knowledge is positively correlated with innovative performance. Similarly, the finding by Mota and Cilento (2020) also showed that knowledge positively correlates with internet use.

However, there is no correlation between attitude and organic fertilizer adoption. In this regard, farmers appear to focus on information and their long-time experience in adopting organic fertilization, particularly in the field of almond production. In contrast, Nandi et al (2015) found that attitude is positively correlated with organic fruit and vegetable cultivations.

For the first hypothesis (H1), the result showed that there is a statistically significant influence of knowledge on organic fertilizer adoption. The finding for this hypothesis is in line with Ajayi (2007), who found that farmers have a good understanding of soil fertility issues. Farmers are well experienced in analysing information on various aspects of organic fertilizer adoption; however, the majority of the farmers have no formal education and therefore cannot read published news and material on the standard use of organic fertilizers. This study’s finding is also in line with Yusuf et al (2021), who found a significant relationship between knowledge and charcoal consumption practices but not with attitude. A similar finding by Marsh et al (2017) indicated that farmers’ knowledge is associated with organic farming, which is known for its safety, high-quality production, and premium price attributes. Pushpa Malkanthi (2020) also found that knowledge is associated with organic agriculture and highlighted its potential for development of the organic agriculture in the study area.

For the second hypothesis (H2), the result found that there is no statistically significant impact of attitude on the adoption of organic fertilizers. The researchers achieved the same result as that of Drury and Farhoomand (1999), who conducted a study on innovation diffusion and implementation. They found no statistically significant relationship between attitude toward the outcomes of the innovation and the adoption chronology. Nevertheless, the early and late adopters use alternative sources of information, such as experience with similar technology, their own prior experience with the existing technologies, or other organizations, to reduce the uncertainty associated with the adoption of technologies under consideration. While Islam (2020) found that farmers’ attitude has a positive and significant relationship with organic farming, the present study’s finding is in line with the study of Nandi et al (2015), in which farmers consider organic fertilizer as a safe and environmentally sound approach toward sustainable farming since it involves organic production and conservation of natural resources.

For the third hypothesis (H3), the result showed a statistically significant impact of practice on the adoption of organic fertilizers. This finding is similar to the work of Chuang, Wang, and Liou (2020), who found practice impacts on smart agriculture innovation adoption. However, farmers working in the sector of agribusiness have higher adoption than self-employed farmers. The present study's finding is also consistent with Donate and Guadamillas (2015), who found that human resource practices significantly influence innovation performance. Similarly, Nishi et al (2019) also found that practice has a significant impact on the participation of organic farming.

The findings by Shams and Fard (2017) revealed that farmers' knowledge and attitude were beneficial when those structural factors were favourable toward the adoption of organic farming; that is, high educational level, higher income, larger farm size, better knowledge about organic farming, and greater access to information resources all contribute to a favourable attitude toward organic farming. In addition, Ahmad et al (2020) found that while practice had no statistically significant impact on green fashion innovation adoption, knowledge and attitude had a statistically significant impact.

As the findings showed, both knowledge and practice strongly influenced the adoption of organic fertilizers. Almond smallholder farmers are using organic fertilizers for the sake of environmental safety (animals, humans, soil, plants, and ecosystems), considering its long-term effects while maintaining the ability to enhance almonds production. The present study's findings are similar to Nishi et al (2019) who found that most of the respondents adopt organic fertilization to improve soil fertility and that it is cheaper than chemical fertilizers.

Conclusions

This research explored the concept of organic fertilizer adoption in Uruzgan, Afghanistan, and investigated the impact of knowledge, attitude, and practice (KAP) on organic fertilizer adoption. To date, there is no study that investigated similar variables in Uruzgan, Afghanistan.

The results showed a positive correlation between knowledge, practice, and organic fertilizer adoption. However, there was no correlation between attitude and organic fertilizer adoption. The outcomes from multiple regression analysis further revealed that knowledge and practice were the positive and significant predictors of organic fertilizer adoption. Contrarily, there was no relationship between attitude and organic fertilizer adoption. Therefore, the importance of knowledge and practice should be emphasized as the foundation for promoting organic fertilizer adoption.

Almond smallholder farmers should employ organic fertilizers in their production. It is scientifically proven to improve soil fertility and enhance soil water holding capacity, resulting in increased almond tree productivity. It is also less expensive than inorganic or chemical fertilizers. Moreover, the adoption of organic fertilization is an environmentally sound approach that can reduce toxicity to the ecosystem due to leaching and minimize the impact of farming.

Recommendations

The results of the demographic profile of the respondents suggest that most of the respondents neither had cooperative membership nor received extension visits. Thus, the provision of adequate support from pertinent agencies is necessary. Furthermore, these findings recommend that agricultural research and development organizations should focus on improving market access and ensuring the availability of organic fertilizer technologies. Providing systematic and practical training courses pertinent to the application of environmentally friendly technologies such as organic fertilizers in agriculture may also enable farmers to engage more efficiently in organic fertilizer practices.

This study also recommends that extension agents and relevant organizations support almond smallholder farmers by sharing information on effective and sustainable practices for managing almond pests and disease epidemics for sustainable production. The findings of the study provide the Ministry of Agriculture, Irrigation, and Livestock (MAIL), educators, and policymakers with valuable insights that can be used to target interventions that enhance or facilitate the adoption of organic fertilizer technologies.

However, it should be noted that there are several aspects that will require further research in the future. Firstly, such studies should be extended to other provinces in Afghanistan to identify the level of knowledge, attitude, and practice toward organic fertilizer usage. Secondly, there is a need for a study to include actual behaviour, as this study only covers behavioural intention toward organic fertilizer adoption. Academic organizations and researchers should use the opportunity to determine smallholder farmers' behaviours to organic fertilizer adoption.

Acknowledgements

The authors would like to thank the Universiti Putra Malaysia in particular, the Department of Agriculture Technology for the research facilities, and the Afghanistan National Agricultural Sciences and Technology University (ANASTU), and the Department of Agriculture (DOA) and the farmers in the Tarin Kowt district of Uruzgan province for assisting this project.

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