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Rice Farming Technology Adoption: A Gender Perspective on Technology Acceptance Model

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Abstract

Rice farming technologies are revolutionizing agriculture by enhancing productivity, financial efficiency, sustainability, and livelihoods. This study examines demographic characteristics and technology adoption patterns among male and female rice farmers in Misamis Oriental and Lanao del Norte, Northern Mindanao, Philippines, highlighting prevalent machinery and practices used. A survey of 286 farmers (156 males and 130 females) provided insights into backgrounds, technology utilization, and perceptions. Results indicate that while male farmers are the majority, female farmers tend to be older. Most farmers have a high school education and are members of farmers' associations. Both genders adopt a range of rice farming machinery, including mud boats, turtles, and harvesters, though ownership is limited across genders. Using TAM, the study evaluates how well the farmers perceive technology acceptance by examining perceived ease of use, usefulness, and attitude towards use. Structural Equation Modelling (SEM) analysis indicates significant links between these constructs and suggests that farmer perception substantially affects the adoption of rice farming technology. The research concludes that gender as a variable also moderates technology acceptance and use, although it seems that gender does not have a significant impact on the overall attitudes towards adoption, which points out the differences in needs and views for male and female farmers. Such evidence would mean that there is a difference between men and women in the adoption of rice farming technology. The research adds to the knowledge of the determinants of technology acceptance in agriculture and highlights the need for gender-based policies and programs. Considering such needs of men and women farmers can assist policymakers in increasing the adoption of technology and in the development of agriculture in a more gender-equitable way.

1. Introduction

Agriculture is a crucial industry that plays a significant role in achieving a country's inclusive economic growth (Paulino & Amora, 2019; Alvaro et al., 2021). It requires technology that enables farmers to translate vast statistics into knowledge and improve financial efficiency (Foyster, 2020).

In the Philippines, the rice industry substantially addresses food security concerns (Ambong, 2022). Rice production technologies positively affect farmers, but institutional factors like education and technological information are critical (Ambong, 2022). Consequently, rice farmworkers achieve higher earnings due to increased efficiency facilitated by utilizing agricultural machinery (Alvaro et al., 2021). Farmers use farm machinery technology to perform rice farming operations (Paman et al., 2019).

Rice farming mechanization is essential in boosting rice production from land preparation to harvesting, reducing labor costs (Bautista, 2020; Khatiwada et al., 2021). Philippine farmers acknowledge the numerous benefits of utilizing farm machinery instead of manual labor despite the high cost and the inevitable displacement of workers (Bautista et al., 2017). Likewise, rice mechanization helps farmers cope with challenges brought by climate changes and trade liberation (Ogre et al., 2022). However, it is not directly associated with yield increases (Bautista, 2020), and the mechanization level has not progressed much over the past three decades (Orge et al., 2022). Additionally, adopting such technologies is slow, mainly due to discrepancies in how technology is promoted versus how it is utilized by farmers (Antolin et al., 2015).

Correspondingly, gender differences significantly shape the intention to adopt new technology across various disciplines (Goswani & Dutta, 2016). Technology is most likely suitable and applicable to individuals for whom it is specifically designed (Rola-Rubzen et al., 2020). Technology development, viewed through a gender lens, involves the collaboration of both male and female farmers in developing innovative technology (Mujawamariya et al., 2022). Moreover, the gender of the household head is correlated with the decision of farmers to embrace rice technology (Miguel et al., 2021).

Hence, this study aims to analyse and explore the adoption of rice farming types of machinery by men and women farmers in Misamis Oriental and Lanao del Norte. Specifically, it sought to identify the characteristics of men and women farmers involved in adopting rice farming technology as to Gender, Age, Marital Status, Educational Background, Farming Background, and Technical Background. Likewise, it determines the agricultural technologies for rice farming adopted and utilized by men and women farmers. Through the technology acceptance model and structural equation modelling, this study assesses the perception of the acceptance and utilization of farm technologies among men and women farmers as to Perceived Ease of Use (PE), Perceived Usefulness (PU), and Attitude Toward Use (AT). It also aims to determine the moderating effects of gender on technology acceptance.

2. Literature Review

2.1 Factors Influencing Agricultural Technology Adoption

A substantial body of literature has investigated the factors that influence the adoption of agricultural technology (e.g., Beshir & Wagary, 2014; Doss, 2006; Doss et al., 2003; Feder et al., 1985; Feder & Umali, 1993; Ogada et al., 2014; Uaiene et al., 2009). As defined by the OECD, technology adoption is a comprehensive concept influenced by various factors, including the development, dissemination, and application of the technology at the farm level.

One of the factors is the gender empowerment. Aryal et al. (2020) emphasizes the importance of gender empowerment in the agricultural industry, highlighting the need for women to be involved in the decision-making process for agricultural technology adoption, with a particular focus on extension and training services. Women farmers benefit from technological advancements like mechanization, which enhance productivity and improve their lives. These advancements benefit their families and contribute to their welfare and education. As the international community works towards the UN's Sustainable Development Goals, it is crucial to provide resources for these women to face future challenges (Nićin, 2021).

However, the sex of the household head has often been used as a gender indicator in many empirical studies examining technology adoption. However, this approach overlooks the variations in adopting agricultural technology based on gender (e.g., Diiro, Ker, & Sam, 2015; Gaya et al., 2017; Kassa et al., 2013). Women in male-headed households frequently collaborate with their spouses when making production decisions. At the same time, males (such as adult sons) in female-headed households also partake in these decisions (Bourdillon et al., 2002). Consequently, using headship as a gender indicator does not fully account for gender roles, a gendered division of labour, or gender politics in adopting agricultural technology (Gebre et al., 2019).

Some studies, including those by Tanellari et al. (2014) and Addison et al. (2018), have moved beyond headship as an indicator, examining differences in technology adoption at the plot-manager level by using the sex of individual farmers as the gender indicator. However, this approach may not fully capture the nuances of gender differences in agricultural settings where plots are managed jointly by male and female farm household members and the decision-making role. Doss (2015) and Manfre et al. (2018) caution against potentially flawed policies that do not consider how access to information and inputs varies among genders, which could lead to joint or independent decision-making depending on social norms and cultural mandates.

2.2 Government Support and Challenges in Mechanization

Government support is crucial for farmers to acquire and adopt technologies that enhance mechanization (Mariano et al., 2012; Dalman et al., 2023). The Philippine Center for Postharvest Development and Mechanization is a government agency actively working to enhance technical capabilities for mechanization, addressing barriers such as farmers' inaccessibility to agricultural knowledge and experiential learning (Davalos et al., 2022). This program ensures the efficient operation and maintenance of mechanization technologies, aiming for sustainable adoption. Mechanization has reduced manual labor demand and indirectly affected crop yield by improving efficiency, productivity, and economies of scale (Rodulfo et al., 2021)

Despite these efforts, Filipino farmers face significant challenges in adopting technology. Over the past three decades, attempts to improve mechanization have been hindered by persistent issues such as poverty, inadequate education (Alcantara et al., 2022), pests, diseases, weather conditions, and high input costs (Bautista, 2027). Many farmers, especially older ones, are subsistence or micro-farmers, making them particularly vulnerable to physical and economic risks (Davalos et al., 2022). Even with government aid, many farmers struggle to achieve satisfactory profits (Dalman et al., 2023). Specific challenges to rice mechanization include a lack of capital, limited access to quality metal parts and skilled workers, inadequate custom service providers, small-sized fields, deep-muddy soils, lack of sustained support, high costs, and the impacts of climate change (Bautista et al., 2023).

2.3 Technology Acceptance Model

Technology acceptance is an expansive notion influenced by farm-level development, diffusion, and use. Other influential elements include agricultural money, resources, education, training, counsel, and information that are the foundation of farmers' knowledge.

In like manner, literature provides various frameworks and models on the factors affecting technology adoption and utilization in different fields. The technology acceptance model is one of the models that has been widely used to determine the adoption of technology in the agricultural sector. The technology acceptance model describes the relationship between perceived ease of use, perceived usefulness, and attitude toward using technology (Davis, 1989).

Davis (1989) proposed the technology acceptance model (TAM) to anticipate and explain the adoption of technology based on the Theory of Reasoned Action. TAM asserts that when deciding whether to accept a technology, a user will primarily consider perceived usefulness and ease of use. Perceptions are influenced by both internal and external factors, including personality traits, self-efficacy, experience, and social norms (Chow et al., 2012; Morris & Venkatish, 2000; Venkatish & Davis, 2000). Perceived usefulness is an individual's belief that technology will improve job performance, whereas perceived ease of use is the ease with which the technology will be used. Thus, individuals are more likely to adopt technology if they believe it is valuable and straightforward. Moreover, TAM has successfully predicted individual behavior across various information technologies in studies of the causal link between belief, attitude, intention, and conduct (Mustafa et al., 2021).

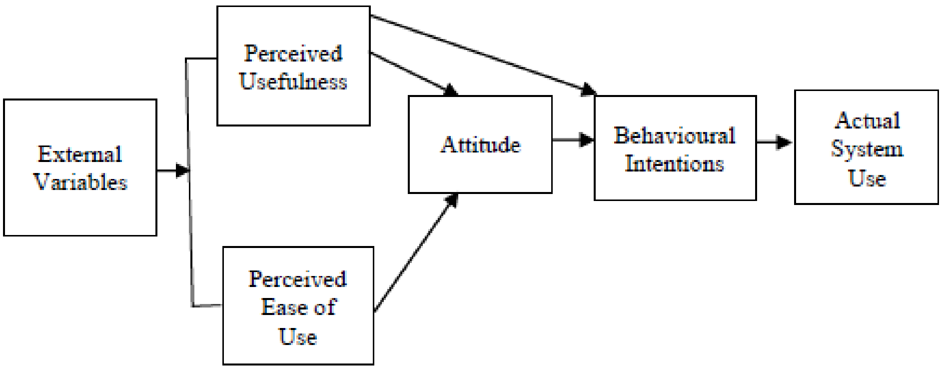

Fig. 1 *Technology Acceptance Model (adopted from Davis, 1989)*

This study chose TAM since it effectively explains technology adoption behaviors in rice farming machines on key constructs like perceived ease of use and perceived usefulness. These constructs are significant for farmers who adopt technologies to enhance farming productivity and efficiency. Since TAM has been widely validated across various fields, it is an appropriate model for examining the constructs.

2.4 Hypothesis

Based on Figure 2 and Figure 3, hypotheses were formulated per the literature above and according to the constructs of perceived ease of use, perceived usefulness, and attitude toward use. In addition, gender is used as a moderating variable of the three constructs.

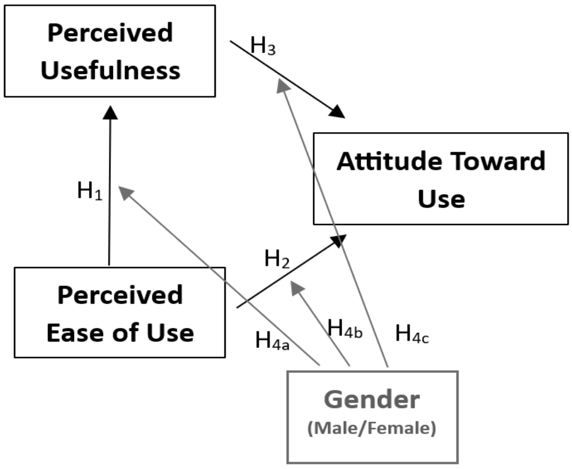

Fig. 2 *Hypothesized model of Technology Acceptance Model (TAM) with gender as moderating variable*

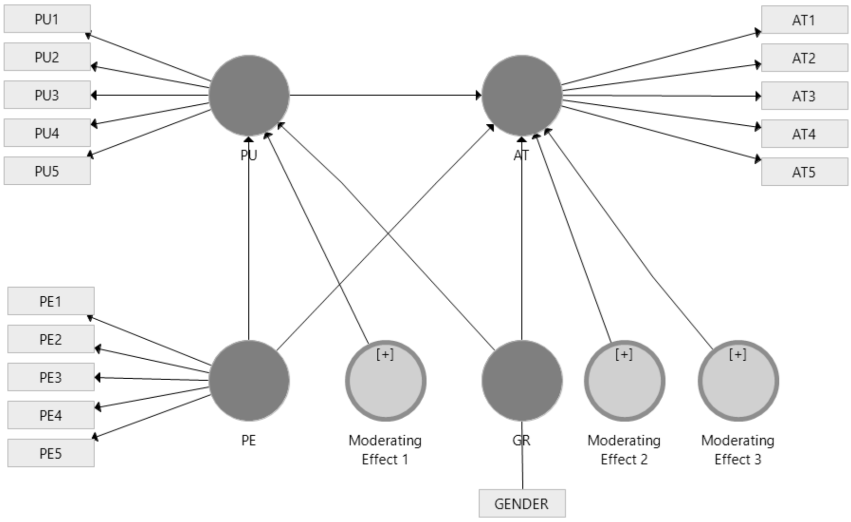

Fig. 3 *Hypothesized model of Technology Acceptance Model (TAM) with gender as moderating variable using SMART PLS software for structural equation modelling*

Influence of perceived ease of use and perceived usefulness on attitude toward technology use.

Perceived ease of use (PE) and perceived usefulness (PU) are critical factors in determining users' attitudes toward technology adoption. Perceived ease of use refers to the level of effort required to use technology, with individuals more likely to adopt technologies they find easy to operate (Davis, 1989). On the other hand, perceived usefulness is the extent to which individuals believe that using the technology will enhance their work performance, such as completing tasks more efficiently (Davis, 1989).

Research consistently demonstrates a positive relationship between perceived ease of use and perceived usefulness, where technologies that are easier to use are also seen as more beneficial (Ma et al., 2017; Chen et al., 2019; Rezvani et al., 2022). This relationship is particularly relevant in agricultural contexts, where ease of use and usefulness are essential for encouraging technology adoption among farmers. The Technology Acceptance Model (TAM) effectively predicts user attitudes by examining the links between belief, attitude, intention, and behaviour (Mustafa et al., 2021). Attitudes toward technology use are influenced by factors such as tangible benefits (Tarhini et al., 2014), usefulness in enhancing productivity (Zeweld et al., 2017), and gendered vulnerability (Khoza et al., 2019). However, Ambong and Paulino (2020) argue that ease of use does not always predict attitudes in all contexts.

Building on these insights, this study proposes the following hypotheses:

- *Hypothesis 1: Perceived ease of use significantly influences farmers' perceived usefulness in utilizing rice farming technology*
- *Hypothesis 2: Perceived ease of use significantly influences farmers' attitudes toward using rice farming technology.*

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Furthermore, perceived usefulness directly influences attitudes, acting as a mediating factor in adopting agricultural technologies. Research by Purnawirawan et al. (2012) and Zhang et al. (2022) highlights the mediating role of PU, with studies showing that PU positively affects users' attitudes in various contexts, including mobile payment systems (Lui et al., 2021) and farming technologies (Ambong & Paulino, 2020). Therefore, this study proposes a third hypothesis:

- Hypothesis 3: Perceived usefulness significantly influences farmers' attitudes toward using rice farming technology.

Moderating effects of gender on technology acceptance.

Although gender was not part of the original TAM (Venkatesh et al., 2003), much literature has proven that it has moderating effects. As a moderating variable, gender partially moderates the extended TAM model (Zhang et al., 2022) and is an essential element in technology acceptance (Binyamin et al., 2020). The exciting finding of Setiawan et al. (2023) reveals that gender (men) significantly affects women regarding perceived usefulness; however, men are lower than women regarding perceived ease of use.

Similarly, Na et al. (2021) investigated the moderating effect of gender on the relationship between technology readiness and consumer intention. Likewise, Kim (2016) proves the moderating role of gender on the relationship of the technology acceptance model. Finally, Alshurideh (2021) found that perceived usefulness and simplicity of use significantly influence customers' intention to use e-payment systems, which is also influenced by gender. Therefore, the hypotheses regarding gender as a moderating factor are:

- *Hypothesis 4a. Gender significantly moderates the relationship between perceived ease of use and perceived usefulness in utilizing rice farming technology.*
- *Hypothesis 4b. Gender significantly moderates the relationship between perceived ease of use and attitude toward using rice farming technology.*
- *Hypothesis 4c. Gender significantly moderates the relationship between perceived ease of use and attitude toward using rice farming technology.*

3. Methodology

3.1 Quantitative Data Collection

This study collected quantitative data from farmers in Lanao del Norte and Misamis Oriental. According to (Taherdoost, 2021), in quantitative data collection, survey questionnaires are frequently utilized to gather statistically significant information and serve as a valuable instrument for research and assessment purposes. Quantitative methods involve collecting, analyzing, interpreting, and writing study results, including identifying samples and populations, designing designs, presenting results, making interpretations, and writing research consistent with survey or experimental methods (Creswell & Creswell, 2023).

3.2 Survey Design and Instrumentation

Aligned with the study's objectives, this survey uses an adapted questionnaire based on the three constructs of the technology acceptance model, focusing on perceived ease of use, perceived usefulness, and attitude toward use, with gender as a moderating variable. Five Likert-scale questions were used to gauge participants' levels of agreement or disagreement (from 1 - Strongly Disagree to 5 - Strongly Agree) with statements related to these TAM constructs. The survey questionnaire was translated into the vernacular (Cebuano/Bisaya) as part of the procedure so the participants could quickly understand the questions.

3.3 Sampling and Data Collection Procedure

Soper's (2024) a-priori sample size calculator for structural modeling was used to determine the sample based on constructs and items. This calculator computes the sample size for a structural equation model investigation, considering variables, effect size, and power levels to determine the minimum required to detect desired effects. A total of 286 farmers, 156 males and 130 females, participated in the survey, the majority of whom are members of the farmers' association, which is greater than the calculated minimum sample size for a model structure of 100, the minimum sample size to detect an effect of 119, and the recommended minimum sample size of 119 at 0.3 or medium anticipated effect size.

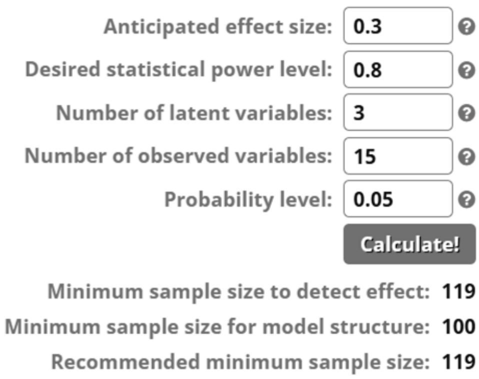

Fig. 4 *Soper's a-priori sample size calculator for structural equation modelling*

After the ethics committee approval, the researchers contacted the chief executive or mayors of the Lanao del Norte and Misamis Oriental in Northern Mindanao, Philippines, for entry protocol and for permission to survey farmers through the local agricultural officers, technicians, and farmer organizations. The translated survey included the research overview and emphasized participants' voluntary involvement. Aside from being translated, the questionnaire items were explained to the farmers so they could answer.

3.4 Data Analysis

Data analysis was conducted in two stages; for descriptive analysis, Microsoft Excel was utilized to organize and analyze the demographic data, such as age, gender, marital status, educational background, membership in the farmers' association, certifications, technical background, etc. Microsoft Excel was chosen for preliminary data organization and descriptive analyses such as frequency, percentage, mean, and median statistics (Coursera, 2023; Rashid, 2024).

For the analysis of the hypothesized constructs, the quantitative component utilized Structural Equation Modelling (SEM) to analyze the complex relations of the constructs. Structural Equation Modeling is a set of statistical methods used to estimate relationships between constructs and indicators while accounting for measurement error (Hair et al., 2021; Hair et al., 2022) and methods for testing hypotheses about causal effects among observed or proxies for latent variables (Kline, 2023). SmartPLS was employed to analyze the hypothesized constructs through structural equation modeling. It was selected for its robustness in handling SEM, which is suitable for exploring relationships between multiple latent constructs. The SmartPLS allows for bootstrapping and other advanced SEM techniques that support model validation and hypothesis testing, making it ideal for analyzing the constructs of perceived ease of use, perceived usefulness, and attitude toward technology in this study. The SmartPLS 3 software program helped analyze the complex relationships between latent variables (i.e., mediation, moderation, etc.), which they measured through sets of observed variables (Cheah et al., 2024). Additionally, SMART PLS provides important reliability and validity measures, including Cronbach's Alpha, Composite Reliability, and Average Variance Extracted (AVE), ensuring the constructs' robustness and accuracy.

4. Results and Discussions

4.1 Farmers' Characteristics and Backgrounds

The result of the characteristics and backgrounds of the farmers as to their gender is explicitly detailed in Table 1 below. In the surveyed population of 286 participants, 156 individuals, composing 54.55%, are identified as male, while 130 individuals, constituting 45.45%, are identified as female. This data suggests that a slight majority of males are male compared to females.

The data highlights that agricultural tasks are customarily performed by males, highlighting areas where the percentage of male farmers is higher than that of female farmers. This higher percentage of male farmers is consistent with previous Panday et al. (2010) studies.

However, it is significant to note that recent advancements in Philippine agriculture and mainstream gender (Ani & Casosola, 2020) have facilitated more excellent women's involvement in agriculture, supporting the notion that there's no significant difference between the number of male and female farmers. This shift challenges the traditional gender roles and supports the advocacy that both genders can equally perform agricultural activities, fostering an inclusive environment in the highly conventional agricultural sector.

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Table 1 *Frequency of the gender of farmers*

Gender	Frequency	Percentage
Male	156	54.55%
Female	130	45.45%
TOTAL	286	100%

Aside from the gender of the farmers, Table 2 provides data presenting male and female individuals' average and median ages. On average, males have an age of 49.68 years, while females have an average age of 53.68 years. Regarding the median age, males have a median age of 50, while females have a median age of 55. The available data shows that women are typically a little older than men. Additionally, based on median ages, half of the population is under 50 for men, and half is under 55 for women.

According to the Manila Times (2023), the average age of Filipino farmers ranges from 55 years old to 59 years old. This highlights that the farmer's aging population may significantly affect the agriculture farming sector. Agriculture has a lot of potential, yet production has declined over time, affecting farmers' standard of living. Agriculture jobs increasingly require less expertise and produce less, contributing to decreasing interest in the sector. Moreover, with the average age of farmers, Filipino youth are increasingly seeking opportunities beyond agriculture (Maruja M. B. Asis, n.d).

Data also shows that female farmers are older than their male counterparts. This finding aligns with the study of Mishra et al. (2017), which states that women play a critical role in developing countries' agricultural and rural economies. Rural women perform a wide range of production and farm management tasks. In the Philippines, women work in agriculture more frequently than males do.

Table 2 *Average and median age of the farmers*

Age	Average	Median
Male	49.68	50
Female	53.68	55

Another characteristic of the farmers is found in Table 3, Based on the frequency and percentage distribution of marital status among male and female individuals. The most significant portion of individuals, males and females, are under the married category, composed of 73.08% males and 70.00% females. This implies that the majority of the participants are currently married. Under the single category, males had a total of 10.90% while females had 1.54%. This suggests there are more single males compared to females. For the widow/widower category, females comprise 20.00% of the population. This indicates a higher proportion of widowed females compared to males. However, for males, it is presented with a smaller percentage of 5.13%

Other marital statuses are less common for both genders. Separated is comprised of 1.28% male and 3.08% female. Live in has a data of 8.97% for males and 4.62% for females. Annulled is the last overall, comprising 0.64% male and 0.77% female. The data shows differences in marital status distribution between males and females, especially regarding the percentages of single and widowed individuals.

The data shows a large number of married male farmers. In most farming occupations, wives don't have a prominent involvement. Their role becomes more evident when the production process ends and the product is ready to be turned into cash, stored, and sold. Wives are beginning to participate in the management of produce instead of merely waiting for their husbands to provide the money from farming. The influence of wives in decision-making also relates more to financial decisions (Vargas, 2022).

Table 3 *Marital status of farmers*

MARITAL STATUS	FREQUENCY		Percentage	
	Male	Female	Male	Female
Single	17	2	10.90	1.54
Married	114	90	73.08	70.00
Widow/Widower	8	26	5.13	20.00
Separated	2	4	1.28	3.08
Annulled	1	1	0.64	0.77
Live-in	14	6	8.97	4.62
TOTAL	**156**	**130**	**100**	**100**

Table 4 shows the frequency and percentage distribution of educational attainment among male and female individuals is shown in the statistics provided. There were 49 people in the Elementary Level, comprising 20 females and 29 males, or 18.59% and 15.38% of the total population. Similarly, 47 individuals were in the Elementary Graduate category, including 21 men and 26 women, or 13.46% and 20.00% of the total population.

The High School Level counted the highest response with 76 participants, representing 47 males and 29 females, or 30.13% and 22.31%. Thirty-eight men and thirty-five women were counted in the High School Graduate category, making up 17.95% and 26.92% of the total population.

At the college level, there were 25 individuals, with 16 males and nine females making up 10.26% and 6.92%. Additionally, there were 21 College Graduates, 12 male and nine female, constituting 7.69% and 6.92% of the total population. Moreover, one individual achieved a postgraduate level, a female, representing 0.77%. Finally, four individuals were in the Vocational category, with three males and one female, accounting for 1.92% and 0.77%.

The data shows that genders differ in their degrees of educational attainment, with men more likely to be represented in some categories, such as high school level and high school graduate. In contrast, women lead in others, like elementary and college graduates. In total, the majority of male farmers have a high school level of education. Traditions and cultural norms could have a role in this occurrence. Traditional gender roles may exist in some areas, where men are typically expected to work in physical labor-intensive jobs like agriculture rather than pursuing higher education (Doyle et al., 2019).

Table 4 *Educational background of the farmers*

EDUCATION	FREQUENCY		Percentage	
	Male	Female	Male	Female
Elementary Level	29	20	18.59	15.38
Elementary Graduate	21	26	13.46	20.00
High School Level	47	29	30.13	22.31
High School Graduate	28	35	17.95	26.92
College Level	16	9	10.26	6.92
College Graduate	12	9	7.69	6.92
Post Graduate	0	1	0.00	0.77
Vocational	3	1	1.92	0.77
TOTAL	**156**	**130**	**100**	**100**

Table 5 indicates the farmer's membership in the farmers' association. The data provided shows how members of a Farmers' Association are distributed according to gender. A total of 286 individuals were surveyed, of which 148 male and 123 female, or 94.87% and 94.62% of the total membership, are members of a farmer association. Meanwhile, a lower percentage of individuals, eight males and seven females, or 5.13% and 5.38% of the total, are not association members. The data reveals that there are numerous participants, both male and female, who are members of a specific association. One of the determining factors is the benefits they can obtain by being a member of this association. The primary goal of these farmer associations is to ensure improved access to public services. Farmer groups can request government assistance by requesting a letter from the provincial agricultural office (Paje, 2021).

Table 5 *Membership of farmers in farmers association*

Membership in the Farmers Association	FREQUENCY		Percentage	
	Male	Female	Male	Female
Yes	148	123	94.87	94.62
No	8	7	5.13	5.38
TOTAL	**156**	**130**	**100**	**100**

The provided data in Table 6 shows the distribution of years of membership, divided by gender, within a particular group or organization. There is a difference in membership duration among the 286 individuals surveyed at different times.

Forty-nine females and eighty-two males have been members for one to five years, making up 52.56% and 37.69% of the total membership. In comparison, 41 men and 39 women are listed in the 6–10 years, accounting for 26.28% and 30.00% of the total membership. Additionally, the data shows lower frequencies during more extended member periods. For instance, nine males and nine females are in the 11–15-year age group, making up 5.77% and 6.92%. Six males and 12 females are in the 16–20 age group, or 3.85% and 9.23% of the total population. There are also seven males and eight females in the 21–25 years age group, which comprise 4.49% and 6.15% of the total population; four males and five females in the 26–30 years age group, which comprise 2.56% and 3.85% of the total population, and five males and six females with 31 years or more of membership. Additionally, only two men and two women did not indicate their years of membership.

The data illustrates a varied distribution of membership durations, with a predominant presence of members in the 1-5- and 6-10-years categories. In the Philippines, farmer organizations are essential to advancing sustainable agricultural development. They give small-scale farmers a stronger voice and better status in society. They also help them become more resilient and contribute to rural prosperity and food security (Paje, 2021).

Table 6 *Years of membership in the farmers association*

Years of Membership	FREQUENCY		Percentage	
	Male	Female	Male	Female
1-5 years	82	49	52.56	37.69
6-10 years	41	39	26.28	30.00
11-15 years	9	9	5.77	6.92
16-20 years	6	12	3.85	9.23
21-25 years	7	8	4.49	6.15
26-30 years	4	5	2.56	3.85
31 or more years	5	6	3.21	4.62
TOTAL	**154**	**128**	**100**	**100**

Technical Education and Skills Development Authority (TESDA) certifications among males and females, specifically focusing on agricultural production certifications, are considered relevant in the Philippines. Table 7 outlines the distribution of TESDA certifications. In the Agricultural Crops Production NC I certification category, there are two males and 15 females, representing 1.28% and 11.54%. Similarly, for Agricultural Crops Production NC II, there are 17 males and 14 females, making up 10.90% and 10.77%. Agricultural Crops NCI and NCII got the highest number of responses. In 2022, according to TESDA, agricultural competencies were strengthened to help individuals acquire knowledge and skills, particularly in regions where crops are widely available.

Furthermore, Agricultural Crops Production NC III recorded five male recipients, with no females reported. Organic Production NC II has two male and no female recipients, comprising 1.28%. Grains Production NC II has five male recipients, with no female recipients recorded, accounting for 3.21%. Meanwhile, Dairy Farming NC II shows no male and one female recipient, representing 0.77% of the total. The data also highlights that few farmers have TESDA-related training and certifications.

The data highlights various TESDA certifications for agricultural production among males and females. While there is a presence of both genders in specific certification categories, such as Agricultural Crops Production NC I and NC II, others show a predominance of one gender, such as Agricultural Crops Production NC I, where it comprises 15 females and only two males. Leilanie Adriano (2019) states that males and females are given equal opportunities to pursue TESDA-offered courses. In recent years, more women are engaged in agriculture, contributing significantly to the sector's growth and sustainability.

Table 7 *TESDA certifications of farmers*

TESDA Certifications	FREQUENCY		Percentage	
	Male	Female	Male	Female
Agricultural Crops Production NC I	2	15	1.28	11.54
Agricultural Crops Production NC II	17	14	10.90	10.77
Agricultural Crops Production NC III		5		
Organic Production NC II	2		1.28	3.85
Grains Production NC II	5		3.21	
Dairy Farming NC II		1		0.77
No Response				
TOTAL	26	35	16.67	26.93

Another characteristic of the farmer is their years of farming engagement; Table 8 data provides an understanding of how farmers are distributed by gender and how many years they have been involved in farming. There are 20 females and 228 males in the 1–5 years in farming, making up 15.38% and 17.95% of the total. In contrast, 27 males and 28 females are in the 6–10 years of membership, making up 17.31% and 21.54% of the total population. Regarding longer involvement durations, 13 males and 11 females are in the 11–15 years of membership, comprising 8.33% and 8.46%.

Twenty-four males and 17 females have been farming for 16 to 20 years. They constitute 15.38% and 13.08% of the total population. In contrast, there are 14 males and 13 females in the 21–25 years, comprising 8.97% and 10.00% of the total population. Additionally, in the 26-30 years category, fifteen males and nine females are engaged in farming, accounting for 9.72% and 6.92% of the total population.

For a longer time frame, there are 16 males and 10 females in the 31–35 years, accounting for 10.26% and 7.69% of the total population. Meanwhile, 11 males and seven females, 7.05% and 5.38% of the total population in the 36–40 years of membership have worked as farmers. Lastly, eight males and 15 females fall into the category of having been farmers for 41 years or longer. These individuals make up 5.13% and 11.54% of the total population.

The findings reveal that length of experience is advantageous to the farmers; however, studies identified musculoskeletal disorders like pain in their legs (Swangnetr et al., 2014) and developing clinical lumbar instability with low back pain (Puntumetakul, 2014) in rice field preparations. The ergonomic risk of health conditions is likely due to the demanding nature of agricultural work.

Table 8 *Years of involvement/engagement in farming*

Years	FREQUENCY		Percentage	
	Male	**Female**	**Male**	**Female**
1-5 years	28	20	17.95	15.38
6-10 years	27	28	17.31	21.54
11-15 years	13	11	8.33	8.46
16-20 years	24	17	15.38	13.08
21-25 years	14	13	8.97	10.00
26-30 years	15	9	9.72	6.92
31-35 years	16	10	10.26	7.69
36-40 years	11	7	7.05	5.38
41 or more	8	15	5.13	11.54
TOTAL	**156**	**130**	**100**	**100**

4.2 Rice Farming Technology (Machineries) Adopted and Mode of Ownership

The data in Table 9 presents the frequency and percentage distribution of the adoption and utilization of various rice farming technologies, specifically the machinery used by farmers in the production process, categorized by gender.

Among the listed machines and technologies, the Mudboat is the most commonly used, with 100 males and 76 females utilizing it, representing 64.10% and 58.46% of the total population. The Harvester is next, having been adopted by 47 males and 51 females, or 30.13% and 39.23%. Male and female adoption rates for other machines, like the Turtle, Thresher, Tractor, and Transplanter, differ but still show a significant adoption. Notably, the carabao and cow are still being used for farming, which is part of the life of some farmers. Furthermore, some machines, like the Sprayer, Weeder, Hutavator, and Plantsa, show little acceptance.

Overall, the data shows that the population has a different environment for adopting machinery and technology; some equipment, such as the Mudboat and Harvester, are more extensively used by both genders than others. However, most machinery/technology tools are predominantly utilized by male farmers. A possible reason is the less support and productive resources available to female farmers compared to male farmers' services (Tufa et al., 2022). Despite this, it's essential to recognize that male and female farmers can use technology in their agricultural methods as effectively. The necessity of empowering all farmers, regardless of gender, is becoming increasingly apparent, so efforts to achieve equality in technology adoption are proliferating (Cole et al., 2022).

Table 9 *Names of rice farming technology/machines*

Name	FREQUENCY		Percentage	
	Male	Female	Male	Female
Mudboat	100	76	64.10	58.46
Turtle	12	15	7.69	11.54
Harvester	47	51	30.13	39.23
Sheller	6	7	3.85	5.38
Thresher	23	19	14.74	14.62
Tractor	13	6	8.33	4.62
Transplanter	12	7	7.69	5.38
Sprayer		1		0.77
Weeder	1		0.64	
Hutavator	1		0.64	
Daro (Plow)	1	2	0.64	1.54
Carabao	14	7	8.97	5.38
Baka (Cow)		1		0.77

One particular concern in the utilization of the technology of rice farming machines is the ownership of it by the farmers. The data in Table 10 shows the ownership status of property divided by gender within a specific category. It includes information on how males and females divide up ownership responsibilities.

The most common ownership status among those listed is "Leased," which accounts for 90 males and 80 females, or 56.96% and 61.54% of the total participants. Next, 25 males and 17 females report "Owned" assets, accounting for 16.03% and 13.08% of the total participants. The next category is "Gov. Owned" assets, which comprise 18 males and 14 females, or 11.39% and 10.77% of the total participants. Three males and four females claim "financed" assets, accounting for 1.90% and 3.08%. With two males and three females in the "Company Owned" arrangement and three males in the "Partnership" arrangement, the frequencies of these arrangements are comparatively lower.

In addition, three females and one male examples of "Cooperative Ownership," accounting for 2.31% and 0.63%. In addition, no information is provided for other categories, including "Shared Ownership," "Joint Venture," "Inherited," and "Donated."

The data shows that those surveyed had various ownership arrangements, with "Leased" assets being the most common. It implies that different types of ownership, such as government ownership, corporate ownership, partnerships, cooperative ownership, and personal ownership, are practiced by both males and females.

Table 10 *Status of ownership of the technology utilized*

Status	Frequency		Percentage	
	Male	Female	Male	Female
Owned	25	17	16.03	13.08
Leased	90	80	56.96	61.54
Financed	3	4	1.90	3.08
Gov. Owned	18	14	11.39	10.77
Company Owned	2	3	1.27	2.31
Partnership	3		1.90	
Shared Ownership				
Joint Venture				
Cooperative Ownership	1	3	0.63	2.31
Inherited				
Donated	1		0.63	

The findings revealed that factors affecting or influencing ownership of farm machines and implements have limitations. These may be due to limited access to credit, small farm sizes and fear of job displacement (Alave, 2012), High cost of purchasing (Manila Standard, 2022), and lack of training and technical knowledge (Huo et al., 2022). However, in India, ownership of agricultural machinery and implements is influenced by the size of landholding, access to irrigation, and access to institutional credit.

4.3 Perception of the Acceptance and Utilization of Rice Farming Technologies/Machineries

The following figures depict the Structural Equation Model (SEM) analyzed using the Smart PLS Algorithm. It shows the path coefficients of the hypothesized Model in Figure 2 and Figure 3. The model includes the Perceived Ease of Use (PE), Perceived Usefulness (PU), and Attitude Toward Use (AT), as well as Gender as a Moderating variable.

It shows the outer model loadings that indicate the relationships between the observed variables and their corresponding latent variables. The loading reveals that all observed variables have a strong positive relationship with their respective latent constructs, indicating a good measure of their respective constructs.

The figures also show the path coefficients in the inner model, which indicates the strength and direction of the relationship between the latent constructs. The figure also depicts how gender as a moderating variable influences the relationships between the constructs.

Specifically, figure 5 depicts the adjusted R-square values, which provide insights into how the model explains the construct variation, particularly Perceived Usefulness (PU), which is 0.409, which means Perceived Ease of Use and Gender can explain 40.9 % of the PU variation. Likewise, the Attitude Towards Use (AT) is 0.581 or 58.1% of the variation in user's attitudes towards using the technology is regarded by Perceived Usefulness, Perceived Ease of Use, and gender.

Overall, the model seems supported strongly by the high outer loadings, implying that the observed variables effectively represent their corresponding latent constructs. The path coefficients show positive relationships, suggesting that Perceived Ease of Use improves Perceived Usefulness and Attitude Toward Use. Similarly, Perceived Usefulness positively influences attitude toward use. However, gender appears to have a feeble effect on relationships. The adjusted R-square values show that the model accounts for a significant variance in Perceived Usefulness and Attitude Toward Use. Thus, the model provides essential insights into how perceived ease of use and usefulness frame user's attitudes towards adopting technology, while gender has a minimal role in moderating the effects.

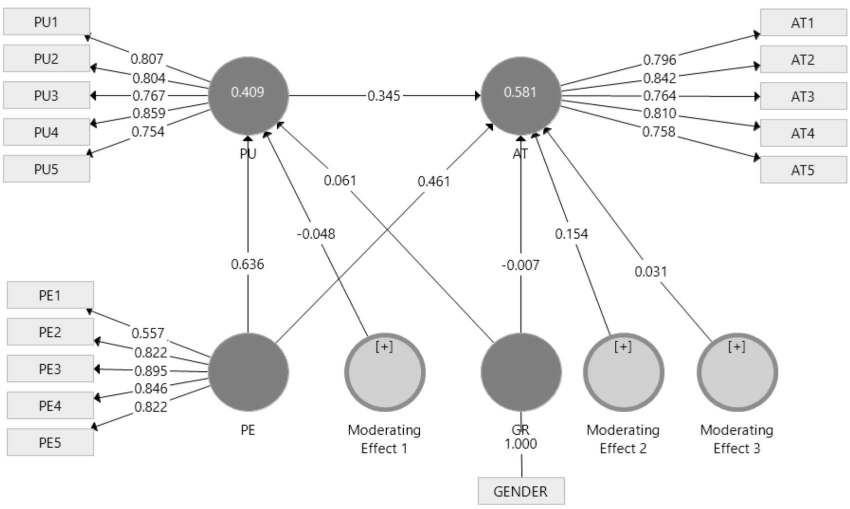

Fig. 5 *Structural result of smart PLS Algorithm emphasizing path coefficients in the inner model, outer model loadings, and constructs' R-square adjusted*

The Average Variance Extracted (AVE) represents Figure 6, and the values measure how much variance constructs represent versus the variance due to a measurement error. Higher AVE values indicate better convergent validity. This also shows that the variance in the AVE of PE (0.636), PU (0.638), and AT (0.631) indicators is captured by these constructs. All constructs have AVE values above 0.5, showing good convergent validity and demonstrating the model's relationships and effects. Likewise, high outer model loadings indicate strong indicators for each construct, and path coefficients suggest significant influence. However, minimal effects of gender significantly moderate the relationship between the constructs, particularly PE and PU.

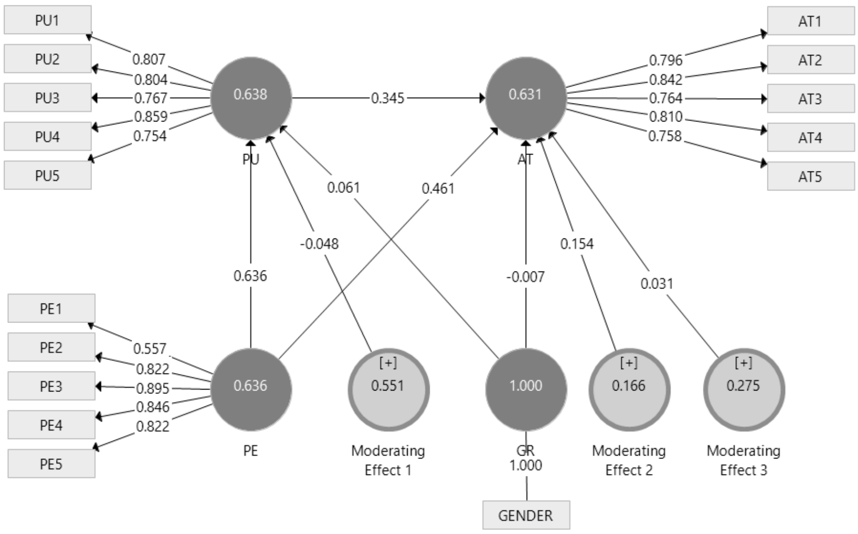

Fig. 6 *Structural result of smart PLS algorithm emphasizing path coefficients in the inner model, outer model loadings, and constructs' Average Variance Extracted (AVE)*

Figure 7 is the bootstrapping analysis of the model. Bootstrapping helps assess the stability and reliability of the results by repeatedly sampling the data (Hair et al., 2017). This helps confirm that the relationships observed are not due to random choice. Specifically, it highlights the high path coefficient and the significant p-value.

The figure helps interpret the significance and strength of the hypothesized relationships. It offers valuable insights into how well the observed variables represent their latent constructs and how gender might modify the relationships. For example, PE to PU has a path coefficient of 0.636 and a p-value of 0.000; PU to AT has a path coefficient of 0.345 and a p-value of 0.000; and PE to AT has path coefficient of 0.461 and a p-value of 0.000. All the values indicate a strong and statistically significant relation between the mentioned constructs. However, gender shows a non-significant moderating effect, as indicated by its value, which is based on the yellow-green circle arrow pointing to the constructs.

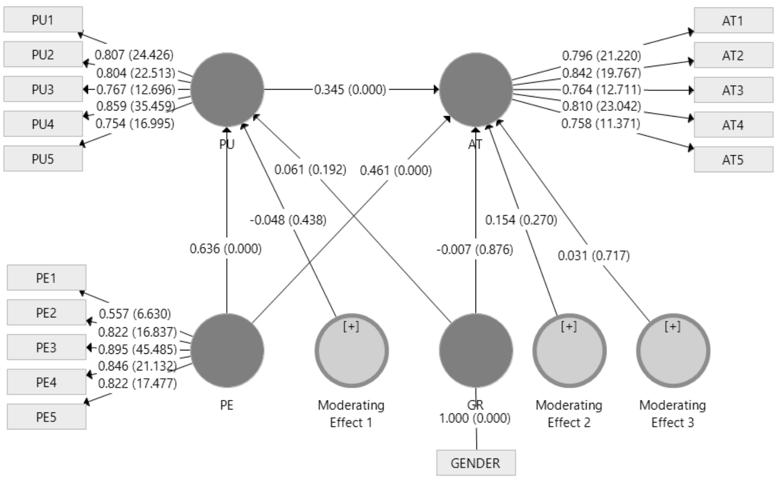

Fig. 7 *Bootstrapping relationships of the constructs with the path coefficients and p-values and loading and p-values of each observed construct variable*

Figure 8 shows the bootstrapping results emphasizing the path coefficients and t-values of the model. The figure highlights the values in parenthesis next path coefficient and loadings. High T-values indicate that the path coefficients or loadings are statistically significant, while low T-values imply that they are not statistically significant. High T-values mean the likelihood is that the observed relationship or effects in the model are real and not due to random chance. Low t-values have a weak relationship or possibly due to a random variation rather than an actual underlying pattern (Hair et al., 2017)

For example, PE to PU has a coefficient of 0.636 with a T-value of 10.256; PE to AT has 0.461 with a T-value of 5.446; and PU to AT has 0.345 and a T-value of 4.214. The corresponding values indicate and suggest a significant positive relationship. However, the moderating effects of gender do not significantly moderate since its values are lower.

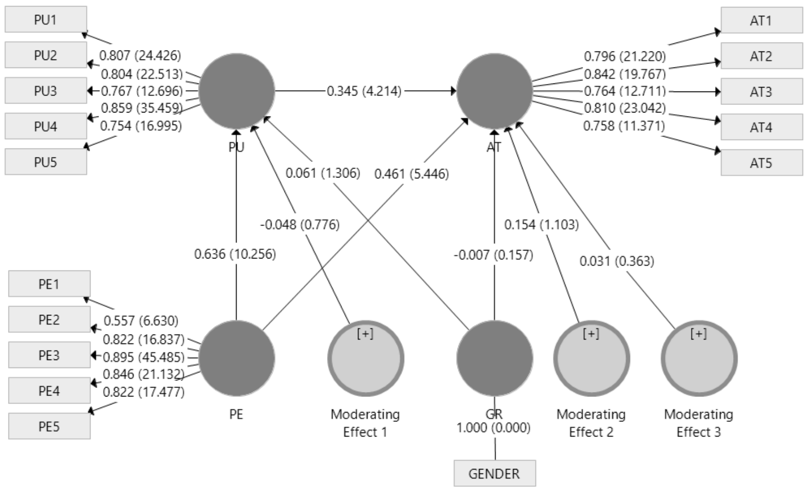

Fig. 8 *Structural result in bootstrapping emphasizing path coefficients and T-values and loading and T-values of the outer model*

In summary, the figures illustrate the relationship between constructs. Tables 11 and 12 explain the details of Figures 5, 6, 7, 8, and 9, outlining the particular relationship of the data in each figure.

Table 11 below is the Confirmatory Factor Analysis (CFA) to validate the factor structure of the TAM constructs. It confirms that each set of items loads significantly on their respective factors. By performing CFA, the researchers aimed to verify that the observed survey items reliably measure their respective latent constructs. This step ensures that each construct is distinct and valid, which contributes to the overall reliability of the study's measurement model (Hair et al., 2021). As shown in the table, it also assesses the measurement reliability through Cronbach Alpha and composite reliability, with high values indicating consistent and reliable measurement of the constructs. Using AVE, CFA also evaluates convergent validity where values should be above 0.5, confirming that items adequately measure the constructs. Overall, CFA ascertains the constructs in TAM are measured reliably and validly.

Table 11 *Confirmatory factor analysis*

Factor	Items	Loadings	Cronbach Alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average Variance Explained (AVE)
Perceived Ease of Use (PE.)	PE1	0.557	0.851	0.880	0.895	0.636
	PE2	0.822				
	PE3	0.895				
	PE4	0.846				
	PE5	0.822				
Perceived Usefulness (PU.)	PU1	0.807	0.858	0.860	0.898	0.638
	PU2	0.804				
	PU3	0.767				
	PU4	0.859				
	PU5	0.754				
Attitude Toward Use (AT)	AT1	0.796	0.853	0.856	0.895	0.631
	AT2	0.842				
	AT3	0.764				
	AT4	0.810				
	AT5	0.758				

Table 11 represents the constructs, items per contract, and the Cronbach alpha, composite reliability (rho_a), composite reliability (rho_c), and the average variance explained (AVE) that describes the reliability and validity of the items.

Respectively, the indicator loadings of the items of each construct are 0.708 or higher, which is highly preferred (Hair et al., 2017), highlighting the item's ability to evaluate the constructs reliably with validity. However, PE 1 has 0.554 loadings but is retained since the Average Variance Explained (AVE) of PE is more than 0.50, which explains a considerable proportion of the variance among its items. At this stage, all items have satisfied the convergent validity guidelines for assessing the reflective model. Conforming with Cheung et al. (2023) reiteration of reporting composite reliability, constructs PE, PU, and AT are deduced to satisfactorily meet the internal consistency requirements. Consequently, the Cronbach Alpha and composite reliability scores further verify its high internal consistency and reliability.

Table 12 *Relationship of the constructs of technology acceptance model*

Hypothesis	Relationships	Path Coefficients (β)	T-values	P-values	Interpretation
H1	PE -> PU	0.636	10.256	0.000	Significant
H2	PE -> AT	0.461	5.446	0.000	Significant
H3	PU -> AT	0.345	4.214	0.000	Significant
H4a	GENDER x PE -> PU	-0.048	0.766	0.438	Not Significant
H4b	GENDER x PE -> AT	0.154	1.103	0.270	Not Significant
H4c	GENDER x PU -> AT	0.031	0.363	0.717	Not Significant

Table 12 summarizes the hypothesized result of the relationships between constructs based on figures 3-7. The results of hypothesis testing reveal the following:

H1: Perceived ease of use (PE) significantly influences farmers' perceived Usefulness (PU) in utilizing rice farming technology. The path coefficient is 0.636 with a high T-value of 10.256 and a significant p-value of 0.000, manifesting strong support for this hypothesis. In other words, as people perceive technology to be easier to use, they also perceive it to be more practical, which suggests that there is indeed a significant positive relationship between perceived ease of use and perceived usefulness (Scherer et al., 2019)

H2: Perceived ease of use (PE) significantly influences farmers' attitudes toward using (AT) rice farming technology. The path coefficient is 0.461 with a T-value of 5.446 and a significant p-value of 0.000, indicating strong support for this hypothesis. This means farmers who find technology more accessible tend to have a more positive attitude towards it. The study on determinants for mobile banking adoption indicates that perceived ease of use has a significant positive relationship with attitude. This aligns with the broader findings of the Technology Acceptance Model, which often applies across various fields and types of technology, including those used in agriculture. Users who perceive technology as easy to operate generally tend to have a more favorable attitude toward using it (Raza et al., 2017). The "Technology Acceptance Model: A Meta-Analysis of Empirical Findings" also confirms a strong correlation between perceived ease of use and attitude towards technology (Qingxiong & Liping, 2004).

H3: Perceived Usefulness (PU) significantly influences farmers' attitudes toward using (AT) rice farming technology. The path coefficient is 0.345 with a T-value of 4.214 and a significant p-value of 0.000, indicating strong support for this hypothesis. These findings suggest that perceived usefulness significantly affects farmers' attitudes and perceptions toward using rice technology. Enhancing the usefulness of agricultural technology could lead to more positive attitudes and perceptions among farmers. This result complements the study of Raza et al. (2017) that perceived usefulness has a positive significant relationship with attitude toward adopting mobile banking and a positive and meaningful relationship between perceived usefulness and users' Attitude (Alikhani et al., 2013). These studies affirm that perception of a system's usefulness significantly influences users' attitudes, with greater perceived usefulness leading to a more positive attitude towards using the system.

However, the moderating effects of gender on the constructs hypotheses 4a, 4b, and 4c reveal contrasting results.

H4a: Gender does not have such significant moderating power in explaining the relationship between perceived ease of use (PE) and perceived usefulness (PU) in agricultural technology. The path coefficient is estimated at -0.048 with a T-value of 0.766 and a p-value of 0.438. The p-value is not significant; therefore, no considerable moderation effect is present.

H4b: Gender does not have such significant moderating power in explaining the relationship between perceived ease of use (PE) and attitudes towards rice farming technology (AT) use. The path coefficient is 0.154, with a T-value of 1.103 and a p-value of 0.270, which is insignificant. There is, therefore, no significant moderation effect.

H4c: Gender does not have such significant moderating power in explaining the relationship between perceived ease of use (PE) and attitudes towards using (AT) rice farming technology. However, The path coefficient is very low and estimated at 0.031 with a T-value of 0.363 and p-value of 0.717 at a 5 percent significance level. There are no significant results to indicate a substantial moderation effect.

Gender does not appear to significantly affect the relationships between perceived ease of use, perceived usefulness, and attitudes toward using agricultural technology. This suggests that the relationships between these variables remain consistent across different gender groups, at least in the context of this study. The findings also support that gender does not impact the constructs (Mansoori et al., 2023) and that the gender role between males and females differs (Marinković et al., 2019). Kalinić et al. (2019) highlight gender-specific differences in technology adoption and decision-making, implicating design and implementation methods. Tarhini et al. (2014) emphasize both theoretical understanding and practical implications of technology acceptance of gender difference in the adoption process and other varying influences of perceived ease of use and perceived usefulness. However, Zhang et al. (2022) found that gender partially moderates the TAM model, indicating a need to tailor interventions to account for gender differences in technology acceptance.

Moreover, the significant findings from hypotheses 1, 2, and 3 emphasize the importance of perceived ease of use and usefulness in shaping farmers' attitudes and perceptions toward rice farming technology. However, in this context, the non-significant findings from hypotheses 4a, 4b, and 4c suggest that gender may not significantly mediate these relationships. Thus, socio-psychological factors and gender-differentiated elements are necessary for effective agricultural policy (Khoza et al., 2020).

5. Implications

Based on the supporting literature and the findings, several significant implications for policy and practice emerge, particularly in addressing gender disparities in technology adoption in agriculture. Gender-sensitive agricultural policies are essential for promoting equitable technology access and fostering inclusive agricultural growth, and this research highlights actionable areas for policymakers and practitioners.

The study indicates that the mechanization of farming tools also benefits men and women alike; however, using this technology might come with more barriers for women. Limited resources, lack of training, and barriers to owning equipment make it more difficult for female farmers to utilize these tools fully (Aduwo et al., 2019). Concerns of these types could be addressed by implementing policies that provide some forms of financial assistance, such as grants or loans, to women farmers. Furthermore, providing training programs specifically designed for female farmers focusing on how to use and maintain machines may enable them to utilize the available technology fully.

The other primary concern is the mechanical configuration of quite a lot of the existing machinery. Most farm machinery and tools are designed for use by men, which further complicates women's work (Kawarazuka et al., 2018; Huyer, 2016). To resolve this, the government could compel manufacturers to create sufficient ergonomic tools that all farmers can use comfortably. This could also involve providing benefits to manufacturers by creating more female-oriented tools.

Furthermore, gender research indicates that female and male farmers' participation in technology development can improve the usability of tools and processes across gender divides (Mujawamariya, 2022). Policy frameworks should encourage technology co-development by including men and women in pilot projects, focus groups, and design sessions. Involving the users in the design of innovations reduces the risk of the agricultural innovations being rejected and increases the chances of the technology being adopted and productivity improvement.

Another important conclusion concerns the government's assistance in accessing needed technology. Like the Department of Agriculture programs, these programs are beneficial in increasing mechanization for productivity (PHilMech RCEF, 2022). This can expand these programs of subsidizing female farmers' projects to break through the existing barriers of gender-based discrimination in accessing government resources. At the same time, there is a need for training and extension services to be increased, targeting women in areas where they wait for their male counterparts to migrate and work on farms. The depth of women's understanding of modern farming can be significantly enhanced through gender-analysed training programs aimed at equipping women with modern farming techniques (Luis et al., 2015).

Lastly, these findings highlight the importance of policies to mitigate the difference in technology adoption intentions between females and their male counterparts. Women often face barriers that make it hard to adopt new technologies, such as limited access to information and information technology, which have been developed to cater primarily to men (Goswami & Dutta, 2016; Rola-Rubzen et al., 2020). By creating initiatives targeting women's technological requirements and preferences, policymakers can help advance a practical and gender-sensitive policy on technology adoption. This includes identifying clear barriers women face in technology adoption and measures to overcome how these barriers work.

In brief, these studies indicate the necessity of the gendered approach of policies aimed at the agricultural sector, which would ultimately assist in narrowing the gap concerning technology access and adoption barriers. Such policies can focus on technology design that caters to all, a fair distribution of resources, and a broader scope of gender-responsive education and access to finances. Such initiatives will assist policymakers and practitioners in creating a farming environment where all farmers, regardless of gender, will participate in and promote the development of sustainable and productive farming practices. This strategy not only improves productivity but also fosters gender equity and strengthens rural economies.

6. Conclusion

The synthesis of findings regarding men's and women's involvement in rice farming agriculture highlights several key insights and challenges. The surveyed number of farmers is primarily male, but women tend to be older than men. Most farmers had a high school education or less, but many were farmers' association members. Both genders adopted varied rice farming technologies. However, ownership of the machinery was limited.

Moreover, the Technology Acceptance Model results show that perceived ease of use and usefulness significantly influence farmers' attitudes toward adopting rice farming technology. Farmers who see the technology as more straightforward to use are more beneficial and more likely to have positive attitudes. Nevertheless, the study found that gender does not significantly affect these relationships, implying that both genders respond similarly to these factors. Hence, strategies should encourage technology adoption and enhance perceptions of use and usefulness.

While there is a positive trend towards greater gender inclusivity in farming, and despite facing cultural norms and unequal opportunities, women play significant roles in agriculture, necessitating efforts to empower them through targeted interventions and support systems. Therefore, the study suggests strategies to encourage the adoption of rice farming technology. Fundamental approaches may include but are not limited to offering tailored training programs and workshops to improve farmer's skills. Financial support, such as subsidies and interest-free loans, can help make technology affordable. They are enhancing access to information though agricultural services provided by the concerned agencies and personnel. Farmer associations serve as vital platforms for accessing resources and technology, and they are also crucial. Likewise, government support and collaborative efforts within farming communities are critical for promoting gender equality in technology access and adoption. This emphasizes the importance of each stakeholder's role in promoting gender equality in technology access and adoption.

Moreover, collaborative investment in rural infrastructure, like better irrigation, is also vital. Finally, supportive and farmer-friendly policies and public-private partnerships can produce a conducive environment for adopting new technologies in rice farming. Addressing gender inequality in agricultural technology access requires concerted efforts to create inclusive policies, strengthen women's leadership roles in farming associations, and provide equitable training opportunities for a sustainable and equitable agricultural future. By recognizing and addressing these challenges, stakeholders can work towards fostering a more inclusive and empowered farming sector that benefits both men and women farmers alike.

The study has several limitations. Firstly, it is limited by the scope of its quantitative sources, primarily on the population. As a result, the finding may not fully capture the diversity of perspectives with the broader population of farmers, potentially impacting the study's comprehensiveness. Future research should consider expanding data sources to include a more diverse sample or additional variables to strengthen generalizability. Secondly, the regional focus of the study limits the generalizability of the findings.

This study can be replicated across different locations or with various technologies to broaden our understanding of technology acceptance in agriculture, offering valuable insights for policymakers and practitioners in diverse settings. Conducting similar research in regions with distinct farming practices and cultural contexts would help determine if the relationships between perceived ease of use, perceived usefulness, and attitudes toward technology adoption are universally applicable. Furthermore, applying this study's framework to other agricultural technologies, such as irrigation systems or pest management tools, could validate these results across different technological contexts. Additionally, reliance on self-reported data may introduce biases; incorporating objective measures of technology use could improve accuracy. Exploring alternative theoretical models could provide a more comprehensive view of technology adoption. Addressing these limitations in future research will more broadly strengthen our understanding of technology adoption in rice farming and agriculture.

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Conflict of Interest

The authors declare no conflict of interest regarding the paper's publication.

Author Contribution

The authors confirm their contribution to the paper as follows: ***study conception and design:*** *Victor S. Rosales, John Alan D. Lee;* ***data collection:*** *Victor Rosales, Glay Vhincent C. Sumaylo, John G. Adil Jr., John Alan D. Lee;* ***analysis and interpretation of results:*** *Victor Rosales, John Adil, Glay Vhincent Sumaylo;* ***draft manuscript preparation:*** *Victor S. Rosales, Michelle Samantha M. Guttierez, John Alan D. Lee. All authors reviewed the results and approved the final version of the manuscript.*

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