DETERMINANTS OF SOLAR POWER ADOPTION IN AGRICULTURAL COOPERATIVES: EVIDENCE FROM THE MEKONG DELTA

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Abstract: ***This study investigates the key determinants influencing agricultural cooperatives' intention to adopt solar power technology in the Mekong Delta, Vietnam. Using data collected from 212 cooperatives through quota sampling, the study applies a mixed-methods approach and employs structural equation modeling to examine the proposed relationships. The empirical results demonstrate that perceived ease of use, perceived usefulness, subjective norms, attitude, and perceived behavioral control all have significant positive effects on adoption intention. This study contributes to the literature by extending behavioral models of technology adoption to the context of agricultural cooperatives, an underexplored organizational setting in emerging economies. The findings also provide practical implications by highlighting the importance of strengthening awareness, institutional support, and resource accessibility to accelerate the adoption of renewable energy technologies in the agricultural sector.***

• Keywords: *solar power technology, renewable energy adoption, agricultural cooperatives, behavioral intention, Vietnam.*

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1. Introduction

Amid growing pressure to diminish pollutions, restructuring the energy system towards the production of green technologies and enhancing the utilisation of renewable energy resources is gaining the attention of many countries (Irfan et al., 2019). Energy transition aims not only to reduce environmental impact but also to ensure energy security and increase the resilience of the economy to global fuel price fluctuations through the development of sustainable renewable energy sources (Nguyen & Hoang, 2023; Rezaei & Ghofranfarid, 2018).

Vietnam is a typical case in the energy transition process in Southeast Asia. With the advantage of high solar radiation, especially in the South and the Mekong Delta, solar power is considered one of the pillars of the sustainable energy development strategy (Tuan, 2020). In the agricultural sector, especially in the Mekong Delta, Vietnam's key rice and aquaculture production region, the demand for electricity for irrigation, preservation, and processing of agricultural products is increasing. Agricultural cooperatives, with their role in organizing collective production and coordinating resources, are considered potential entities in deploying small and medium-scale solar technology.

However, existing studies in the field of renewable energy in agriculture mainly focus on the technical and operational aspects of solar power systems, such as power generation capacity, energy conversion efficiency, and economic feasibility of the technology, while behavioral factors and technology adoption by users are often less considered (Srinivasan et al., 2021; Nguyen & Hoang, 2023). This research void shows that the study of the motives behind the motivation to adopt solar power technology in agricultural cooperatives in the Mekong Delta is of immediate priority. Describing economic determinants, environmental attitudes and institutional settings that influence the decision to adopt green technology would not only result in more research in agricultural renewable energy adoption but could also lay down the scientific background for the planning of energy transition policy at the regional economic level.

2. Literature review

2.1. Theoretical framework

In research on green technology adoption, selecting the appropriate theoretical framework plays a crucial role in explaining the mechanisms of behavioral intention formation, especially for long-term investment decisions such as solar power technology. This has been followed recently by empirical research on the effectiveness of integrating behavioral models for the implementation of renewable energy technologies in enterprises and communities (Nguyen et al., 2023). This is especially critical in collective organizations like agricultural cooperatives, where investment decisions rely on economic rewards, perceptions, social consensus, as well as institutional conditions.

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Out of the widely used theoretical frameworks, the Theory of Planned Behavior (TPB) is one of the most useful models in explaining technology adoption intention. The TPB states that intention to do a behavior is influenced by three components namely attitude toward the behavior, subjective norms, and perceived behavioral control (Ajzen, 1991). In the context of renewable energy applications, these factors have been shown to play an important role in explaining the decision to adopt new technologies by individuals and organizations (Nguyen et al., 2023).

In addition, the Technology Acceptance Model (TAM) emphasizes the role of perceived beliefs directly related to the characteristics of technology, especially perceptions of usefulness and ease of use (Davis, 1989). Empirical studies have shown that these two factors significantly influence attitudes and intentions to adopt solar energy technologies in various contexts (Bouaguel & Alsulimani, 2022). Therefore, integrating TPB and TAM is considered a suitable theoretical approach to more comprehensively explain the factors influencing the intention to adopt solar power technology among agricultural production organizations.

2.2. Research hypotheses

Based on theoretical frameworks and the results of previous studies related to Perceived ease of use, Perceived usefulness, Subjective norms, Attitude and Perceived behavioral control, the authors propose the following hypotheses:

H1: Perceived ease of use positively influences the attitude of agricultural cooperatives towards solar power technology.

H2: Perceived ease of use positively influences the intention to adopt solar power technology by agricultural cooperatives.

H3: Perceived usefulness positively influences the attitudes of agricultural cooperatives towards solar power technology.

H4: Perceived usefulness positively influences the intention to adopt solar power technology by agricultural cooperatives.

H5: Subjective norms positively influence the attitudes of agricultural cooperatives towards solar power technology; and hypothesis

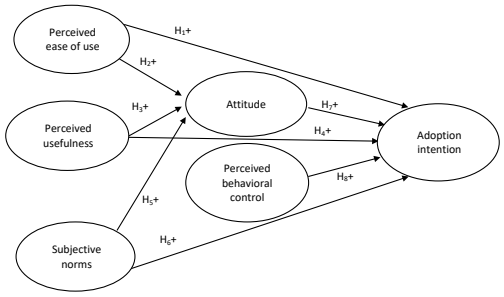
H6: Subjective norms positively influence the intention of agricultural cooperatives to adopt solar power technology.

H7: Attitudes positively influence the intention to adopt solar power technology by agricultural cooperatives.

H8: Perceived behavioral control positively influences the intention to adopt solar power technology by agricultural cooperatives.

Based on the research findings, the research model examining the factors influencing the intention to adopt solar power technology among agricultural cooperatives in the Mekong Delta region of Vietnam is established as follows:

Figure 1: Proposed research model



Source: Authors, 2025

3. Research methodology

The study was conducted using a mixed-methods approach, closely combining qualitative and quantitative research to ensure the relevance and reliability of the results. The qualitative research phase was carried out first, aiming to review, supplement, and adjust the observed variables to better reflect the practical acceptance of solar power technology by agricultural cooperatives. Focus group discussions were conducted in September 2025 with the participation of four experts in the field of renewable energy and four directors/deputy directors of agricultural cooperatives. Based on the results of the focus group discussions, the scales were refined and selectively inherited from previous studies. The scales for the ease of use and usefulness were inherited from Davis's TAM model (1989) and studies on the acceptance of renewable energy technology (Bouaguel & Alsulimani, 2022; Ali et al., 2020). The subjective norms, attitude, and perceived behavioral control scales were constructed based on Ajzen's (1991) TPB theoretical framework and are widely applied in studies on the acceptance of renewable energy technologies (Nguyen et al., 2023). Finally, the intention to accept solar power technology was measured through the level of readiness to adopt the technology in the future, consistent with the standard structure of studies on the behavior of accepting renewable energy technologies (Molnár & Szép, 2024; Nguyen et al., 2023). All observed variables were measured using a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree).

To test the research hypotheses, this study implemented a quantitative analysis process following the steps commonly recommended in behavioral and governance research. First, the reliability of the scale was assessed through Cronbach's alpha coefficient to

determine the degree of internal consistency of the observed variables (Hair et al., 2019). Next, exploratory factor analysis (EFA) was used to identify the latent factor structure and filter out unsuitable measurement variables (Hair et al., 2019). Then, confirmatory factor analysis (CFA) was performed to test the convergent validity, discriminant validity, and overall fit of the measurement model (Kline, 2015). Finally, structural equation modeling (SEM) was applied to assess the causal relationships between concepts and test the research hypotheses (Byrne, 2016).

In studies using SEM, a sample size of approximately 100-200 observations is often considered the minimum acceptable level (Hoyle, 1995). However, sample sizes of 200 observations or more aim to improve the stability of estimates and the reliability of statistical tests in SEM models (Hoelter, 1983; Kline, 2011). Based on this, the formal survey of the study was conducted from October to November 2025 in three provinces/cities in the Mekong Delta region, including Can Tho City, Dong Thap Province, and An Giang Province. Data were collected through direct interviews, combined with the quota sampling technique based on the size and operational sector of agricultural cooperatives. A total of 220 questionnaires were collected, of which 212 valid questionnaires were used for analysis and model testing.

4. Results and discussion

Evaluating scale reliability

The reliability of the scale was tested to assess the degree of internal consistency between observed variables belonging to the same research concept, while identifying and eliminating unsuitable measurement variables that could distort the scale structure (Churchill, 1979). The analysis results showed that all scales achieved a high level of reliability, with the Cronbach's Alpha coefficient of the concepts all greater than 0.8, reflecting the stability and consistency of the observed variables. At the same time, the item-total correlation coefficient of the measured variables was greater than 0.3, meeting the standards in behavioral and management research (Nunnally & Bernstein, 1994; Hair et al., 2017). Therefore, all observed variables were retained and continued to be used in the subsequent analysis steps of the research model.

EFA was performed using Promax rotation. The KMO index reached 0.867 and the Bartlett test was statistically significant (Sig. < 0.05), confirming the data's suitability for factor analysis. The total variance extracted reached 69.99% with an Eigenvalue greater than 1, indicating that the data structure formed six significant factors. All factor loading coefficients were greater than 0.5, ensuring convergent validity, while the difference in factor loading coefficients between structures was greater than 0.3, confirming the discriminant validity of the scales (Hair et al., 1998).

Table 1: Scale Reliability Assessment

Factor	Sign	Cronbach's Alpha	Factor loading	Mean	Standard deviation
Perceived ease of use	PE1	0.854	0.658	3.46	0.812
	PE2		0.745	3.48	0.797
	PE3		0.784	3.45	0.755
	PE4		0.878	3.34	0.757
Perceived usefulness	PU1	0.820	0.750	3.45	0.713
	PU2		0.672	3.43	0.630
	PU3		0.770	3.35	0.658
	PU4		0.724	3.32	0.704
Subjective norms	SN1	0.854	0.711	3.55	0.767
	SN2		0.799	3.46	0.707
	SN3		0.702	3.63	0.815
	SN4		0.847	3.62	0.842
Perceived behavioral control	PB1	0.863	0.753	3.75	0.752
	PB2		0.810	3.78	0.757
	PB3		0.779	3.81	0.722
	PB4		0.718	3.66	0.695
Attitude	AT1	0.840	0.766	3.49	0.701
	AT2		0.765	3.56	0.699
	AT3		0.575	3.51	0.714
	AT4		0.825	3.60	0.707
Adoption intention	AI1	0.841	0.688	3.78	0.635
	AI2		0.687	3.79	0.631
	AI3		0.689	3.66	0.628
	AI4		0.806	3.76	0.632

Source: Author's survey data, 2025

After completing the EFA, the scales were further tested using CFA to assess the model's fit to the survey data. The CFA results showed that the model achieved a good fit with the empirical data. Specifically, the CMIN/df value of 1.725 meets the requirements, reflecting the degree of compatibility between the theoretical model and the observed data (Carmines & McIver, 1981). At the same time, the TLI = 0.928 and CFI = 0.939 are both greater than 0.9, while RMSEA = 0.057 indicates a low approximate error and good overall model fit (Gerbing & Anderson, 1988; Steiger, 1990). Furthermore, the mean variance extracted (AVE) values of the concepts are all greater than 0.5, confirming that the scales converge according to the criteria proposed by Fornell and Larcker (1981). Regarding reliability, the latent constructs all achieve composite reliability (CR) exceeding the recommended threshold, demonstrating the consistency and unidirectional nature of the scale (Jöreskog, 1971). Furthermore, the correlation coefficients between the concepts are all less than 1 and statistically significant, thereby confirming the discriminant validity of the constructs in the model (Steenkamp & Van Trijp, 1991).

Table 2: Correlation coefficients between factors in the model

	CR	AVE	SN	PE	AT	PU	PB	AI
SN	0.868	0.624	**0.790**					
PE	0.858	0.604	0.180	**0.777**				
AT	0.863	0.613	0.597	0.357	**0.783**			
PU	0.822	0.536	0.218	0.227	0.324	**0.732**		
PB	0.863	0.614	0.503	0.226	0.518	0.214	**0.784**	
AI	0.845	0.579	0.545	0.472	0.653	0.432	0.549	**0.761**

Source: Author's survey data, 2025

Testing research hypotheses

The SEM was estimated using the Maximum Likelihood (ML) method on a dataset of 24 observed variables, reflecting 8 structural relationships in the research model. Analysis results show that the model achieves a good fit with the survey data. The Chi-square/df index = 1.757, indicating a good fit between the theoretical model and the empirical data (Carmines & McIver, 1981). Simultaneously, the TLI = 0.925 and CFI = 0.936 indices are both greater than 0.9, while RMSEA = 0.058 reflects a low approximate error, confirming the overall fit of the model (Gerbing & Anderson, 1988). Based on the estimation results, all research hypotheses achieve statistical significance at the 5% level, thus providing empirical evidence to accept the relationships proposed in the model.

Table 3: Testing the research hypotheses

Hypothesis	Relationship	Estimate	P-value	Result
H1	PE → AT	0.228	0.000	accepted
H2	PE → AI	0.238	0.000	accepted
H3	PU → AT	0.159	0.020	accepted
H4	PU → AI	0.205	0.002	accepted
H5	SN → AT	0.533	0.000	accepted
H6	SN → AI	0.175	0.043	accepted
H7	AT → AI	0.305	0.000	accepted
H8	PB → AI	0.213	0.003	accepted

Source: Author's survey data, 2025

Discussion

The results of the empirical analysis show that perceived ease of use positively impacts the attitudes and intentions of agricultural cooperatives regarding the adoption of solar power technology. This indicates that when members of agricultural cooperatives perceive the technology as accessible, easy to install, and convenient to operate, they tend to develop a more positive attitude towards the technology, thereby increasing their intention to incorporate solar power technology into agricultural production. This finding is consistent with the core argument of TAM (Davis, 1989). Simultaneously, the research results reinforce empirical evidence that ease of use is a crucial driver for the adoption of renewable energy technologies at the community and organizational levels (Kardooni et al., 2016; Waheed Iqbal et al., 2018; Ali et al., 2020; Nazir & Tian, 2022; Nguyen et al., 2023). Thus, the study confirms the fundamental role of this factor in the dissemination and deployment of clean energy technology in agriculture.

According to the research results, the perceived usefulness has a positive and statistically significant impact on the attitudes and intentions of agricultural cooperatives to adopt solar power technology. When members of agricultural enterprises believe that this solar power technology serves to enhance environmental quality, optimize energy structure, and provide economic benefits, they are likely to develop a more positive attitude regarding solar energy technology, thereby enhancing their intention to use it during agricultural practices. These findings are consistent with the fundamental argument of TAM (Davis, 1989). Moreover, this evidence supports prior studies indicating that preliminary empirical investigation suggesting a correlation between perceived usefulness of renewable energy technologies and their acceptance in an organizational and community context (Wojuola & Alant, 2017; Waheed Iqbal et al., 2018; Nguyen et al., 2023; Nguyen & Hoang, 2023). Therefore, the study confirms a key role played by perceived usefulness in encouraging a shift toward sustainable energy practices in agriculture.

It is evidenced through the research results that subjective norms play an important role in the perception and intentions of agricultural cooperatives toward solar power technology adoption with a confidence level of 95%. The results suggest that social influence from peers, local communities, and institutional actors significantly shapes cooperatives' attitudes and adoption intentions, influential individuals, and the surrounding community with positive influence on evaluating the positive effects of solar power is found in the attitudes and intentions of members for agricultural cooperative members to adopt a use of solar power in agricultural production. The findings are in agreement with the central contention of TPB (Ajzen, 1991). At the same time, the observation of this result is in line with several studies regarding the adoption of renewable energy technologies, indicating the role of social factors and other individuals around technology change in technology adoptability as well (Korcaj et al., 2015). It is highlighted that the influence of social networks is especially strong on the technology diffusion in emerging economies especially the developing ones (Irfan et al., 2019). Thus, the study adds to evidence of social influence as a strong driver of adoption of renewable energy technologies in agricultural sectors.

For these data, it has been found that attitude plays a positive and significant role on the intention to adopt solar power in agricultural production of agricultural cooperatives. This means that the attitude of agricultural cooperatives individuals to the solar power technology as presented positively increases their intention to apply this technology in the agricultural production. This outcome supports the belief that a positive attitude towards environmental preservation and sustainable development is a key requirement if the acceptance of sustainable technologies is to be promoted (Greaves et al., 2013; López-Mosquera et al., 2014). Simultaneously, the findings are in agreement with the TPB and TAM theoretical constructs, in which attitude emerged as a significant predictor of behavioral

intention (Davis, 1989; Ajzen, 1991). Therefore, the empirical results of the study confirm the essential role that attitude plays in influencing the acceptance and spread of renewable energy solutions in agriculture.

The results in the study show that the perceived behavioral control positively and statistically significantly affects the intention of agricultural cooperatives to adopt solar power technology in agricultural production. This positive correlation suggests that individuals within agricultural cooperatives possess enough knowledge, information, technical knowledge, and financial resources to make an increased intention to apply solar power technology. This point highlights the importance of perceived capacity in lowering hurdles and increasing willingness to adopt emerging renewable energy technologies. The research results are consistent with the TPB, according to which perceived behavioral control is considered one of the most important predictors of future behavioral intentions (Ajzen, 1991). At the same time, the results also reinforce academic arguments that perceived behavioral control has strong explanatory value for the adoption of renewable energy technologies (Abreu et al., 2019; La Barbera & Ajzen, 2020; Nguyen & Hoang, 2023).

5. Conclusion

This study applies a combination of TPB and TAM theories to explain the intention to adopt solar power technology among agricultural cooperatives in the Mekong Delta. Empirical study revealed that perceived ease of use, perceived usefulness, subjective norm, attitude to technology, and perceived behavioral control all promote the intention to adopt solar power technology among the agricultural cooperatives. In particular, attitude towards technology was identified as the most significant variable implying that an accurate perception of economic and environmental advantages of the technology is essential for the consideration of collective agricultural organizations in the decision-making process regarding renewable energy technology adoption.

Academically, the study contributes to expanding the field of research on the adoption of renewable energy technology by applying and testing the integrated TPB-TAM theoretical framework within the context of collective agricultural organizations. Although the majority of prior studies have studied the behaviors of individual households or consumers, this study offers empirical evidence towards the mechanisms behind technology adoption at the cooperative level, which is a key intermediary in agricultural production systems in developing countries. Thus, the findings enrich scholarly appreciation for the motivation behind the behavioral shift towards the clean energy technologies in agriculture.

The findings suggest that adoption of solar power technology of agricultural cooperatives can be increased by a combination of technological and financial elements, but more importantly, by raising awareness and favorable attitude among members of the cooperative regarding green technology. Therefore, agricultural management organizations and development agencies should improve their communication programs, technical training, and accessibility support to promote the benefits of solar power technology. Besides, the increasing access to capital, financing incentives, technological support can be also effective for enhancing perceived control over behaviour, enhancing the intention to use renewable energy technologies in the agricultural industry.

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