Journal of Agricultural Science and Technology (JAST), 28(5)
In Press, Pre-Proof Version

Greenhouse Farmers' Behavioural Intentions to Reduce Pesticide Use for Transition to Agroecological Practices in Antalya-Turkiye: An Expanded Version of Theory of Planned Behaviour

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ABSTRACT

Agricultural practices are increasingly being scrutinised for their environmental impact, particularly with regard to the use of pesticides. Understanding farmers' behavioural intentions is crucial for promoting the transition to agroecological practices. This study investigates farmers' intentions to reduce the use of pesticides in greenhouse cultivation in Antalya Province, Türkiye. Using an extended version of the Theory of Planned Behaviour (TPB), we investigated the socio-psychological factors that influence farmers' intentions to adopt more sustainable practices. Interviews with 297 farmers growing tomatoes, peppers, and eggplants revealed that while farmers generally have a positive attitude towards reducing pesticide use, this attitude does not have a significant impact on their actual intentions. These intentions are chiefly driven by moral norms, subjective norms, and perceived behavioural control. Improving social support, creating an enabling environment, and implementing educational programmes can significantly help farmers to adopt agroecological practices. This study emphasises the importance of understanding the social and psychological factors that influence farmers' decisions, which is essential for developing effective strategies for environmentally friendly agriculture.

Key words: Agroecology, Pesticide Reduction, Farmers' Intentions, Theory of Planned Behavior, Antalya-Türkiye.

1. INTRODUCTION

Agriculture has long been a cornerstone of civilization, meeting essential human needs and supplying raw materials for various industries. However, today, it faces a major transformation to achieve sustainability in harmony with ecosystems. While scientific and technological advances have boosted productivity, they have also introduced complex economic, environmental, and social challenges. To address these issues and ensure a sustainable legacy,

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there is a growing shift away from traditional approaches toward more sustainable practices—most notably, agroecological methods.

Agroecology integrates ecological and social principles holistically to build sustainable food systems. It promotes socially just systems where individuals decide what, how, and where to consume, while optimizing interactions between plants, animals, humans, and the environment (FAO, 2025). Agroecology aims to minimize the use of agrochemicals and energy through intentional agroecosystem design (Altieri and Nicholls, 2017), while preserving biodiversity and sustaining ecosystem services (Wezel et al., 2020). Recognized by FAO as key to sustainable agriculture (FAO, 2021), agroecology highlights agricultural control strategies as a core component.

Pest-related losses pose a major threat to global food security. The Green Revolution relied heavily on chemical pesticides, which initially increased yields (FAO, 1984). However, concerns about health, biodiversity, and environmental harm have raised doubts regarding the the sustainability of these methods (WHO/UNEP, 1989; WRI, 1992; Pimentel, 1996; Aktar et al., 2009). In this context, Deguine et al. (2023) outline five core challenges for 21st-century agricultural control: maintaining productivity, ensuring healthy food, reducing environmental harm, securing farmer incomes, and adapting to climate change. Here, agroecological plant protection (APP) has emerged as a viable solution (Deguine et al., 2020).

APP applies two agroecological principles: leveraging biodiversity and improving soil health. It favors preventive approaches, such as disease-resistant varieties and integrated practices, over sole reliance on pesticides (INRAE, 2023). There is an ongoing global shift towards rethinking pesticide application, with several countries working to limit chemical dependence. For instance, the EU's "Farm to Fork" strategy aims to halve pesticide use by 2030, promoting agroecology as a solution (European Commission, 2020; OECD, 2023). The FAO also advocates for widespread adoption of APP (FAO, 2021).

In Türkiye, agroecological practices such as polyculture, biological control, and organic farming are recognized as effective in reducing pesticide reliance (Öztemiz, 2008; Azizoğlu et al., 2012; Şişman, 2023). With 23.5 million hectares of arable land and 30 agroecological regions, Türkiye has a diverse agricultural landscape (Kaymak et al., 2015). Despite having 2.2 million farms and 6 million agricultural workers, which produces around 140 million tons annually (Birişik et al., 2015), Türkiye faces serious pest issues. Interestingly, it is among the lowest pesticide users globally, with 2.22 kg/ha, less than countries like Israel (14.71), Japan (11.63) or the USA (3.02) (FAOSTAT, 2025). However, pesticide usage is often unregulated, with over 60% concentrated in the Mediterranean, Aegean, and Marmara regions (Delen et al., 2015). Antalya, known for its strong fresh vegetable and greenhouse production, faces significant risks from pesticide residues, driving interest in alternative practices. Studies emphasize the urgency of transitioning from chemical-intensive methods to knowledge-based, ecosystem-focused strategies (Altieri et al., 2024). In Türkiye, agroecological practices such as polyculture, biological control, and organic farming are seen as effective in reducing pesticide reliance (Öztemiz, 2008; Azizoğlu et al., 2012; Şişman, 2023).

To understand the decision-making processes of farmers, recent research employs the Theory of Planned Behavior (TPB), developed by Ajzen (1991). TPB posits that behavioral intentions are influenced by three key components: attitude, which reflects personal evaluations of a behavior; subjective norm, encompassing social pressures and expectations from peers; and perceived behavioral control, indicating beliefs about one's ability to perform the behavior effectively. By examining these interconnected factors, TPB elucidates the psychological drivers behind farmers' choices. This understanding offers valuable insights for designing targeted interventions that promote sustainable agricultural practices and encourage a reduction in pesticide use. Recognizing these dynamics is essential for policymakers and agricultural educators, as it helps create strategies that align with farmers' motivations and social influences, ultimately leading to more environmentally friendly farming methods.

Pesticides play a significant role in modern agriculture but have well-documented adverse impacts on ecosystems and human health (Aktar, et al., 2009). These impacts have spurred research into farmers' pesticide use behaviors and the challenges involved in promoting sustainable and reduced-use practices (Pretty and Bharucha, 2015). Studies show that these TPB components significantly affect farmers' pesticide use behavior (de Bon et al., 2014; Fan et al., 2015; Jallow et al., 2017; Wang et al., 2018; Sarma, 2022; Pirmoghni et al., 2024). Although attitudes and subjective norms are important variables within TPB, perceived behavioral control has emerged as a key factor in studies on pesticide use behavior (Abtew et al., 2016; Schreinemachers et al., 2017; Vidogbena et al., 2016). Expanded versions of TPB also consider additional factors, such as moral norms and government policy awareness (Monfared et al., 2015; Bagheri et al., 2019; Batbay and Kahramanoğlu, 2024; Damalas, 2021). Reducing pesticide use is critical for sustainable agriculture and human health. Understanding farmer behavior through TPB is essential, particularly in high-use systems like greenhouses. Using TPB, this study analyzes greenhouse farmers in Antalya, to assess how attitudes, norms, perceived behavioral control, and moral norms affect their behavioral intentions. The findings are key to shaping strategies that support agroecological practices in greenhouse farming.

2. MATERIAL AND METHODS

2.1. Research Area

In Türkiye, the Mediterranean region has the highest pesticide use in agriculture due to its diverse crop pattern (Özercan and Taşçı, 2022). Erdoğan (2024) attributes this to factors such as crop diversity, widespread pest and disease damage, multiple harvests per season, favorable climate and soil, irrigation availability, extensive greenhouse production, and the region's role in agricultural exports. Within this region, Antalya province has the highest pesticide use, accounting for 7.72% of total national usage (MoAF, 2023). The prevalence of greenhouse farming and high pesticide application makes Antalya a suitable study area.

The study focused on agroecological sub-regions in Antalya where greenhouse cultivation of tomatoes, peppers, and eggplants is concentrated. These sub-regions were selected using the Purposive Sampling Method based on climate, soil, and vegetation to ensure representation of areas where all three crops are grown. Sub-regions I and II (Kumluca, Demre, Kaş, and Aksu) represent tomato and pepper production, while Sub-region III (Alanya, Gazipaşa) represents eggplant production, as shown in Figure 1.

Figure 1: Research area map.

2.2. Data collection tool and sample

The main material of the study consists of survey data collected from 297 farmers who grow tomatoes, peppers, and eggplants in greenhouses in Aksu, Alanya, Demre, Gazipaşa, Kaş and Kumluca districts of Antalya province. The sampling, from the finite population, was estimated using formula in below, employing the Simple Random Sampling Method with population proportions (Güneş and Arıkan, 1988). In the study, p (0.50) and (1-p) (0.50) were taken to reach the maximum sample size. In the study, the 95% confidence interval σ_(px) was calculated as 0.0026 for a 10% margin of error. The sample size was calculated for each product group, and data on the population was obtained from the Ministry of Agriculture and Forestry. According to these data, there were 8,448 tomato producers, 5,433 pepper producers, and 1,156 eggplant producers forming the population in the greenhouse within the research area.

$$n = \frac{Np(1-p)}{(N-1)\sigma_{p_x}^2 + p(1-p)}$$

In the formula:

n = Sample size

N = population size,

p = Estimation Ratio (0.05 for maximum sample size),

$\boldsymbol{\sigma_{p_x}^2}$ = denotes the population variance.

The data come from personal surveys conducted with the farmers between August and September 2023. In this context, a survey was conducted with 103 bell pepper, 105 tomato, and 89 eggplant farmers.

2.3. Research model and hypotheses

The study employed the TPB to examine factors influencing greenhouse tomato, bell pepper, and eggplant farmers' intentions to reduce pesticide use. Ajzen's (1991) TPB serves as a prominent model for examining behavioral intentions (INT), emphasizing attitude (ATT), subjective norm (SN), and perceived behavioral control (PBC) as its three fundamental constructs. ATT involves an individual's evaluations and emotional responses toward a behavior; SN reflects the expectations of significant others; and PBC concerns one's perception of control over performing the behavior (Fishbein and Ajzen, 2010) (Figure 2).

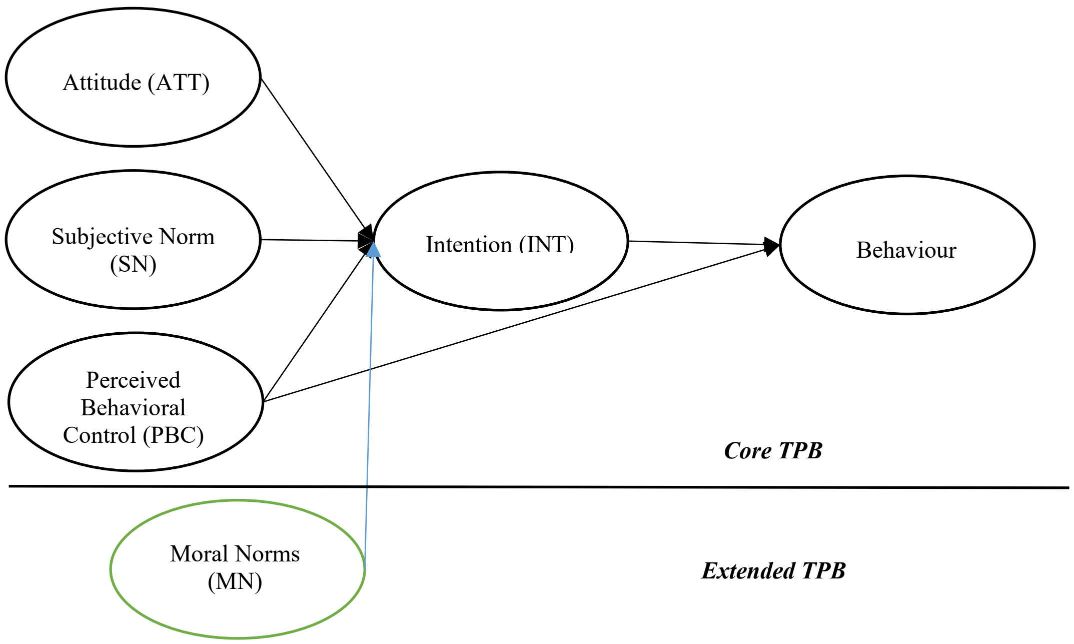

Figure 2: Theory of planned behaviour (modified from Ajzen, 1991).

In this study, the moral norms (MN) variable was included in the model in addition to the ATT, SN, and PBC variables. Scientific literature has documented the integration of MN into the Theory of Planned Behavior (TPB), demonstrating that this variable significantly influences behavioral intention and enhances the explanatory power of models incorporating it (Kaiser and Scheuthle, 2003; Monfared et al., 2015; Bagheri et al., 2019). Given the critical environmental and health implications associated with pesticide use, it is particularly relevant to consider moral norms as a key factor shaping farmers' intentions to reduce pesticide application. Therefore, the TPB framework was extended to include moral norms to better capture these ethical considerations in producers' decision-making processes. In the study, the model was developed within the scope of Ajzen's TPB. The following hypotheses were made regarding the intention of farmers to reduce the use of pesticides in greenhouse agriculture.

H_1: There is a positive correlation between farmers' attitudes towards pesticide use and their intention to reduce pesticide use.

H_2: The variable of farmers' moral norms has a positive correlation on the intention to reduce pesticide use.

H_3: The variable of farmers' perceived behavioral control over pesticide use has a positive correlation on the intention to reduce pesticide use.

H4: Farmers' subjective norms regarding pesticide use have a positive correlation with the behavioral intention to reduce pesticide use.

The measurement instrument used in the study consists of scales that measure five different constructs. Three statements (ATT1, ATT2, ATT3) were used to measure attitude (ATT); three statements (SN1, SN2, SN3), subjective norms (SN); three statements (MN1, MN2, MN3), moral norms (MN); three statements (PBC1, PBC2, PBC3) perceived behavioral control (PBC); and six statements (INT1, INT2, INT3, INT4, INT5, INT6) were used to measure behavioral intention (INT). The scales and their statements are listed in the table. The study employed a 5-point Likert scale (strongly disagree / strongly agree) for its measurements. When developing the scales used in the study, the literature review were taken into account (Table 1).

Table 1: Measurement scale employed in the study based on the extended theory of planned behavior (TPB).

Attitudes (ATT)	
ATT1	Production without the use of pesticides is important for human health.
ATT2	Production without the use of pesticides is important for the production of safe food.
ATT3	Production without the use of pesticides is important for the environment.
Subjective Norms (SN)	
SN1	My close friends think I should use less/no pesticides on my produce.
SN2	My Like-minded farmers support pesticide-free farming.
SN3	My family urges me to limit the use of pesticides in my produce.
Moral Norms (MN)	
MN1	I feel like a better person when I don't use pesticides or use as little as possible in the right dose
MN2	I feel like I am personally contributing to something good when I use less pesticides
MN3	I believe it is morally wrong to prioritize profit over reducing pesticide use
Perceived Behavioral Control (PBC	
PBC1	I believe that I have the means to grow my produce without pesticides.
PBC2	I would have no problems achieving non-chemical pest control.
PBC3	It would be possible for me to switch to non-chemical pest control.
Behavioral Intention (INT)	
INT1	I plan to use fewer pesticides in my production in the near future.
INT2	I plan to replace pesticides with non-chemical pest control methods.
INT3	I plan to start using biological pest control in the near future.
INT4	I am looking at non-chemical pest control options in the future.
INT5	I see myself in the future as someone who is known for selling healthy food.
INT6	I see myself in the future as someone who conducts more research into alternatives to pesticides and attends training to learn about them if needed.

Sources: Bagheri et al., 2019; Yazdanpanah et al., 2019; Savari and Gharechaee 2020; Ataei et. al. 2021.

Confirmatory factor analysis (CFA) and structural equation modeling (SEM) were among the multivariate statistical approaches utilized in the study. Cronbach’s alpha was calculated to assess the internal consistency of the scales. Reliability refers to the consistency of data collection tools in yielding the same results under similar conditions (Aziz, 2014) and is defined as the extent to which an instrument accurately measures the true value of a variable (Özdamar, 2016). Measured between 0 and 1, Cronbach’s alpha assesses how well the scale reflects the construct being measured (Haytko and Matulich, 2008; Özdamar, 2016). A value above 0.70

indicates acceptable reliability. The minimum acceptable KMO sample adequacy value is 0.50 (Sipahi et al., 2010; Özdamar, 2016).

Construct and convergent validity were tested using CFA. CFA is a statistical technique used to assess the construct validity of a measurement model by testing whether the data fit a hypothesized factor structure that is based on theory or prior empirical evidence. It is widely used to examine both construct validity and convergent validity (Brown, 2015) Validity assesses whether the instrument accurately and appropriately measures the intended construct without error (Aziz, 2014). Relationships among the study's hypotheses were analyzed using SEM with latent variables to test model accuracy. Model fit was assessed using several indicators, including chi-square/df, GFI, IFI, TLI, CFI, RMSEA, RMR, and standardized SRMR. The SmartPLS4 program was used to evaluate chi-square/df, NFI, SRMR, d_ULS, and d_G (Ringle et al., 2024). Ideal thresholds are SRMR < 0.08 (Hu and Bentler, 1999; Schermelleh-Engel et al., 2003), NFI > 0.90 (Bentler and Bonett, 1980; Schermelleh-Engel et al., 2003), chi-square/df < 5 for an acceptable fit, and chi-square/df < 3 for a good fit (Wheaton et al., 1977; Schermelleh-Engel et al., 2003; Kline, 2016). Since chi-square is sensitive to sample size, additional fit indices like d_ULS and d_G were used. Henseler et al. (2014) suggest d_ULS and d_G < 0.95 indicate good fit.

The study was analyzed using SmartPLS, which, as a data analysis method, is evaluated in two stages, the measurement model and the structural model (Hair et al., 2014). The model's reliability and validity were further assessed using composite reliability (CR) and Cronbach's alpha (Fornell and Larcker, 1981). Validity was evaluated using Average Variance Extracted (AVE), along with convergent and discriminant validity analyses. The Fornell-Larcker criterion and the HTMT test (heterotrait-monotrait ratio) are used to determine discriminant validity.

3. RESEARCH FINDINGS

In order to understand the intentions of greenhouse producers regarding the reduction of pesticide use and to establish a robust measurement framework for this purpose, the original model, comprising five variables and 24 indicators, was first evaluated for reliability. During the analysis, six indicators that did not meet the reliability criteria were removed, resulting in a revised model consisting of five variables and 18 indicators. Confirmatory factor analysis demonstrated that all remaining scales exhibited satisfactory reliability, thereby confirming the adequacy of the revised measurement model (Table 2). This step ensured that subsequent structural analyses would be grounded on a sound and reliable measurement foundation.

Table 2: Reliability assessment of research scales.

Variables	Cronbach's α coefficient	Composite reliability		Average variance extracted (AVE)
		rho_a	rho_c	
ATT	0.923	0.946	0.951	0.867
INT	0.947	0.948	0.958	0.791
MN	0.954	0.957	0.970	0.916
PBC	0.719	0.727	0.842	0.640
SN	0.790	0.808	0.877	0.706

The study presents the factor loadings, the Cronbach's alpha values, the composite reliability values (rho_a and rho_c) and the AVE values of the indicators for each variable (Table 3 and Fig. 3). An examination of the factor loadings of the indicators shows that they are above the acceptable criterion of 0.70. Similarly, Cronbach's alpha, rho_a, and rho_c values above 0.7, and the AVE above 0.5 indicate that the scale validity is strong (Hair et al., 2022; Hair et al., 2024).

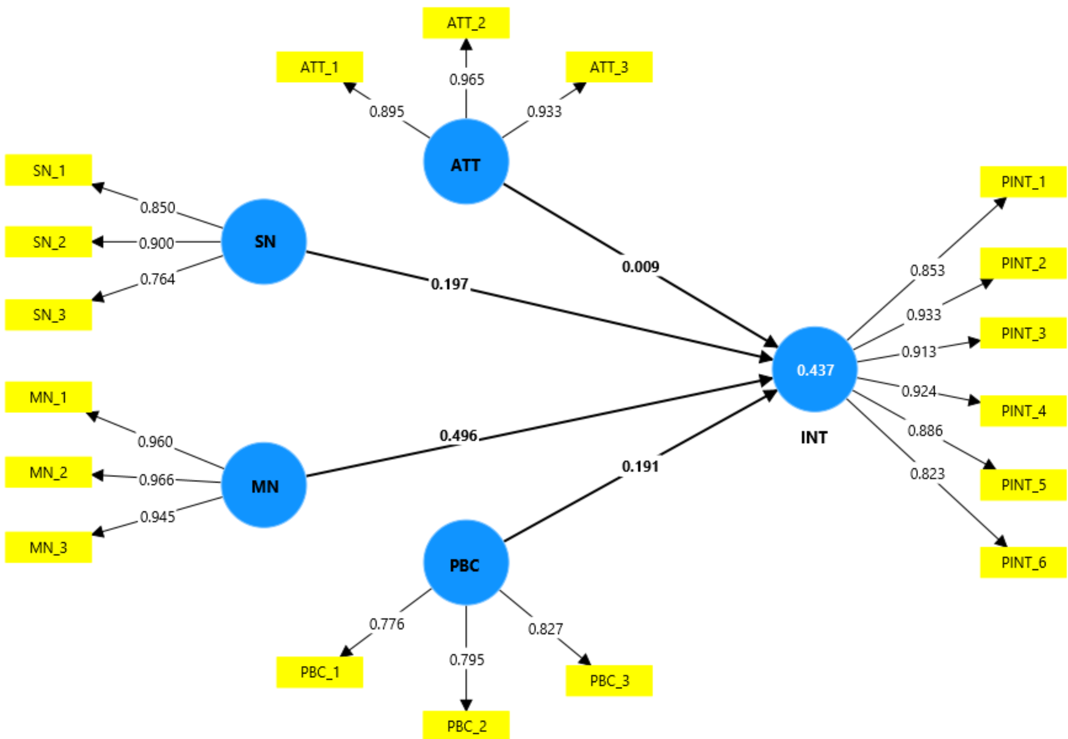

Figure 3: Validity and reliability of research indicator.

Table 3: Loading factor, cronbach alpha and composite reliability.

Variables	Indicators	Loading Factors	Cronbach's α	rho_a	rho_c	AVE
ATT	**ATT_1**	0.895	0.923	0.946	0.951	0.867
	ATT_2	0.965				
	ATT_3	0.933				
MN	**MN_1**	0.960	0.954	0.957	0.970	0.916
	MN_2	0.966				
	MN_3	0.945				
PBC	**PBC_1**	0.776	0.719	0.727	0.842	0.640
	PBC_2	0.795				
	PBC_3	0.827				
SN	**SN_1**	0.850	0.790	0.808	0.877	0.706
	SN_2	0.900				
	SN_3	0.764				
INT	**INT_1**	0.853	0.947	0.948	0.958	0.791
	INT_2	0.933				
	INT_3	0.913				
	INT_4	0.924				
	INT_5	0.886				
	INT_6	0.823				

To ensure the distinctiveness of the constructs used in this study, discriminant validity was assessed using the method proposed by Fornell and Larcker (1981). Discriminant validity examines whether each construct is truly unique by comparing it with other constructs through the square root of the AVE. In the present study, the square roots of the AVE values (highlighted in bold in Table 4) were higher than the correlations with other variables, thereby confirming the discriminant validity of the scales. In addition, the Heterotrait-Monotrait (HTMT) ratio was employed as a complementary and more contemporary criterion for discriminant validity (Hair et al., 2016). HTMT values below 1 indicate adequate discriminant validity (Henseler et al., 2016), and all values in this study met this requirement. These findings demonstrate that the measurement instruments effectively differentiate between constructs, providing a reliable foundation for subsequent analyses (Table 4).

Table 4: Discriminant validity assessment results.

Fornell Larcker Criteria					
	ATT	**INT**	**MN**	**PBC**	**SN**
ATT	**0.931**				
INT	0.160	**0.890**			
MN	0.253	0.598	**0.957**		
PBC	0.025	0.339	0.239	**0.800**	
SN	0.117	0.368	0.280	0.155	**0.840**
HTMT					
ATT					
INT	0.171				
MN	0.269	0.630			
PBC	0.055	0.410	0.288		
SN	0.136	0.426	0.319	0.212	

SEM was employed to test the study's hypotheses. After confirming the measurement model's fit, the structural model was evaluated against the data. The model fit indices are presented in Table 5. The results indicate Chi-square = 496.562, degrees of freedom = 296 (χ^2/df = 1.678), NFI = 0.891, and SRMR = 0.049. Although NFI ideally exceeds 0.90, it is sensitive to sample size and the observed value is considered acceptable (Bentler and Bonett, 1980; Dash and Paul, 2021; Lin et al., 2017; Yusif et al., 2020; Chaigas et al., 2022). Exact fit was further assessed using squared Euclidean (d_ULS) and geodesic distances (d_G), requiring non-significant differences at 95% and 99% confidence levels (Jöreskog and Sörbom, 1996; Wah et al., 2023). As shown in Table 5, no significant differences were observed in either the estimated or saturated model, confirming satisfactory model fit.

Table 5: Summary of model fit statistics.

	Saturated model	Estimated model	P values (0.95)	P values (0.99)
SRMR	0.049	0.049	0.041	0.044
d_ULS	0.405	0.405	0.285	0.333
d_G	0.257	0.257	0.257	0.292
Chi-square	496.562	496.562		
NFI	0.891	0.891		

To assess the structural model, VIF, R^2, f^2, and path coefficient analyses were conducted. VIF analysis checks for multicollinearity between model variables (O'Brien, 2007), with acceptable values below 3 (Diamantopoulos and Siguaw, 2006). The results showed that all VIF values met this criterion (Table 6). Next, the coefficient of determination (R^2) was examined to assess how well independent variables explained the dependent variable. The model explained 43.70% of the variance in behavioral intention. The f^2 analysis, indicating effect size, measured each independent variable's contribution to the dependent variable. Effect sizes are classified as weak ($0.02 < f^2 < 0.14$), medium ($0.15 < f^2 < 0.34$), or strong ($f^2 > 0.34$) (Cohen, 1988). The attitude variable had no significant effect on intention, while other variables generally showed a medium effect (Table 6). Path analysis, the final stage of the structural model, is detailed in Table 6 and Figure 4.

Table 6: Structural equation modelling results.

Hyphothesis	Model	β	St.Dev.	T Value	P Value	VIF	f2
H_1	ATT -> INT	0.011	0.049	0.186	0.853	1.074	0.000
H_2	MN -> INT	0.495	0.045	11.116	0.000	1.201	0.365
H_3	PBC -> INT	0.194	0.040	4.747	0.000	1.074	0.060
H_4	SN -> INT	0.199	0.044	4.438	0.000	1.102	0.063

Table 6 and Figure 4 present the SEM results, showing the effects of ATT, MN, PBC, and SN on INT. The relationship between ATT and INT is positive but small (β = 0.011), suggesting a minimal influence of attitude on intention within this context. In contrast, MN exerts the strongest effect on intention (β = 0.495), indicating that higher moral standards among farmers substantially increase their intention to adopt the behavior. Both PBC (β = 0.194) and SN (β = 0.199) also positively influence intention, demonstrating that farmers' perceived control over the behavior and social pressures from peers and family meaningfully contribute to their behavioral intentions.

The f² values further confirm the relative importance of each predictor, with MN showing a moderate effect, while PBC and SN have small but meaningful impacts. These findings align with the Theory of Planned Behavior: highlighting that intention is shaped not only by ATT but also by MN, PBC, and SN, providing a comprehensive understanding of the factors influencing farmers' decision-making processes.

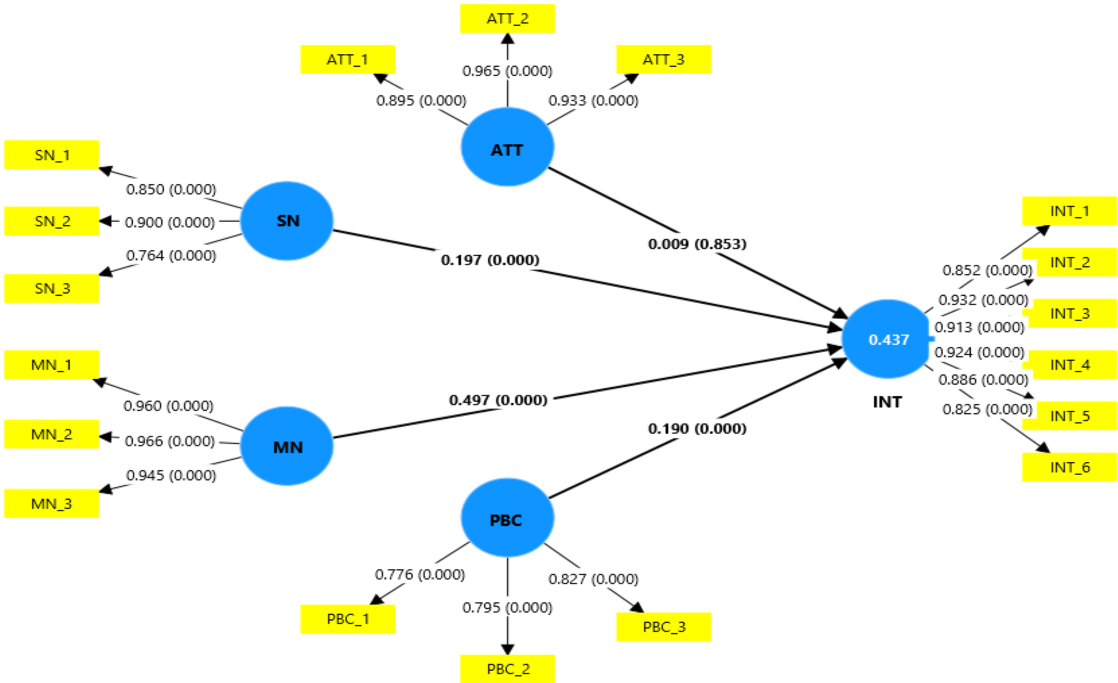

Figure 4: Path analyse diagram.

4. DISCUSSION

Data collected from interviews with greenhouse farmers in Antalya were analyzed using the Theory of Planned Behavior (TPB) to examine pesticide use behavior. Four hypotheses assessed the effects of attitude, subjective norm, moral norm, and perceived behavioral control on farmers' intentions to reduce pesticide use.

The results indicated that MN, SN, and PBC significantly influenced farmers' behavioral intentions, while ATT did not. In this context, PBC control reflects farmers' assessment of the ease or difficulty of not using pesticides, SN capture the influence of others, typically family and friends, and MN represent farmers' ethical evaluation of pesticide use. ATT, referring to the degree to which farmers believe they should reduce pesticide use, was not a significant predictor. Although previous studies often identify attitude as a key determinant of behavioral intention (Bond et al., 2009; de Bon et al., 2014; Fan et al., 2015; Jallow et al., 2017; Wang et al., 2018; Sarma, 2022; Pirmoghni et al., 2024), findings can be inconsistent. For example, Frey et al. (1993) suggest that strong social pressures can limit attitude formation, reducing its predictive power for behavioral intention. Jallow et al. (2017) also reported that even well-informed farmers may fail to take adequate precautions or reduce pesticide use.

In the Antalya region, greenhouse farming is an important source of income, and high economic stakes encourage risk-averse behavior. Farmers prioritize pest control to prevent yield losses and often rely on familiar, effective, and widely used pesticides. Studies indicate that farmers generally prefer proven methods over unfamiliar alternatives (Damalas and Koutroubas, 2014; Stadlinger et al., 2013). These factors may explain why attitude was not a significant predictor of behavioral intention in this study.

Aligned with the TPB, moral norm, subjective norm, and perceived behavioral control positively influenced farmers' intentions to reduce pesticide use. National and international studies report similar patterns, although regional and production system differences may affect results (Bond et al., 2009; Yin et al., 2010; Liu et al., 2013; Abtew et al., 2016; Vidogbena et al., 2016; Schreinemachers et al., 2017; Wang et al., 2018; Sarma, 2022; Pirmoghni et al., 2024). Ajzen (1991) highlighted the central role of these constructs in shaping intentions, and moral norms in particular have been shown to enhance environmental responsibility and promote sustainable practices (Bamberg and Möser, 2007).

Further evidence from other studies supports these findings. Batbay and Kahramanoğlu (2024) found that in Northern Cyprus, higher perceived behavioral control, attitude, and pesticide knowledge were associated with reduced pesticide use, though moral norms were not significant. They recommended that future research consider moral norms in various contexts. In Türkiye, Günay and Niyaz Altınok (2024) reported that while attitude and subjective norm strongly influenced intentions, perceived behavioral control was not significant; additionally, intentions did not always translate into actual behavior. Similarly, Zhang et al. (2024) identified attitude, followed by perceived behavioral control and subjective norm, as the strongest predictors of farmers' intentions to adopt nature-based practices. Monfared et al. (2015) reported that even in the face of notable environmental, economic, and health impacts, farmers in developing countries continued to apply pesticides. The study adopted an extended TPB model by including moral norm and self-identity to better predict pesticide use intentions. Findings indicated that this enhanced model explained 63% of the variation in intentions, surpassing the predictive power of the standard TPB, with attitude, subjective norm, perceived behavioral control, and self-identity as significant contributors. In the extended model, attitude, perceived behavioral control, and self-identity had positive effects, while subjective norm had a negative effect, and moral norms were not statistically significant.

Overall, these findings indicate that while attitude may not always directly predict behavioral intention, social and moral influences, along with perceived control, play a critical role in shaping farmers' intentions to reduce pesticide use, highlighting the relevance of the extended TPB in explaining behavioral intentions in greenhouse farming contexts..

5. CONCLUSION

Controlling plant diseases and pests is a central challenge in greenhouse horticulture, and while chemical methods remain effective, alternative crop protection strategies are increasingly important. This study applied the Theory of Planned Behavior (TPB) to examine how ATT, SN, MN, and PBC influence tomato, bell pepper, and eggplant farmers in Antalya in their behavioral intention to reduce pesticide use. SEM showed that MN, SN, and PBC significantly shaped INT, whereas ATT had a positive but non-significant effect. In Türkiye, strict pesticide residue regulations, particularly for exports, along with growing support for biological alternatives, highlight the need for effective training and policy interventions. The findings suggest that policies should strengthen moral and subjective norms and enhance perceived behavioral control to promote agroecological practices. Reducing pesticide use supports sustainability, food safety, and ecosystem health. Additionally, cost-effective, eco-friendly crop protection aligns with greenhouse production. Overall, the study underscores the role of behavioral factors in farmers' decision-making and the importance of targeted public policies to encourage sustainable horticultural practices.

Acknowledgements

This research was (partly) carried out within the framework of the [ECOBOOST] project. The [ECOBOOST] is part of the PRIMA program supported by the European Union. This project received funding from the Scientific and Technological Research Council of Türkiye (TUBITAK) under Grant Number: 122N053, as part of the PRIMA program.

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