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Drivers of Capia Pepper Farmers' Intentions and Behaviors on Pesticide Use in Turkey: A Structural Equation Model

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ABSTRACT
The main actors responsible for pesticide use behavior are farmers. Still, factors are influencing the pesticide use behavior of farmers in the background. The theory of planned behavior is a widely used concept that explains farmers' pesticide use behavioral intention. However, previous studies show that behavior is not included in the model. As a novelty, it was investigated whether behavioral intention transforms into behavior in this study. In this context, it is the first study conducted in Turkey. Turkey is in the top three for pepper production in the world. In addition, pepper is among the agricultural products that use the most pesticides. This study aims to determine and explain Capia pepper farmers' pesticide reduction intention and pesticide use behaviors in Turkey. For this purpose, the pesticide use behaviors of farmers in the province of Çanakkale, which ranks first in Capia pepper production in Turkey, were analyzed with the Structural Equation Model. Face-to-face surveys were conducted with 206 Capia pepper farmers selected by a proportional sampling method. The research results show that subjective norms and attitudes are important determinants of farmers' willingness to reduce pesticide use. Likewise, perceived behavioral control is a unique factor in farmers' use of pesticides. However, farmers' intentions to reduce pesticide use were not reflected in their actions. It is important to increase awareness among farmers about pesticide behavior. Agricultural policy implications should be planned that target the perceived behavior, subjective norms, and attitudes of farmers regarding pesticide use.

Keywords: Farmer, Theory of planned behavior, Survey, Smart PLS, Pesticide use

1. Introduction

The agricultural sector's role in feeding the global population is paramount, as emphasized by the United Nations (UN 2022). However, as the world population continues to expand, the corresponding demand for increased agricultural production presents a pressing challenge (WB 2022). To meet this demand, the utilization of pesticides in plant cultivation has become a widespread practice since the inception of the Green Revolution, aimed at enhancing yield per unit area (FAO 2017). Farmers have embraced extensive farming methodologies to optimize yields while mitigating the impact of pests and diseases (Govindharaj et al. 2021; Wang & Liu 2021).

1.1. Pesticide use and its significance

Pesticides, chemical agents employed in agricultural production to combat weeds, diseases, and various pests, are central to this perspective (Sharma et al. 2019). The term "pesticide" encompasses any substance or blend designed to prevent, eliminate, repel, or mitigate pests. Pesticides are also deployed as plant regulators, defoliants, or desiccants (USEPA 2022). Remarkably, the global revenue generated from pesticides, encompassing crop protection chemicals, herbicides, insecticides, and fungicides, surpassed $103 billion in 2020. Notably, the revenue from insecticides alone is projected to reach $188 billion by 2031. As of 2020, the top three global consumers of pesticides were China, the United States, and Brazil, jointly constituting 66.0% of the worldwide pesticide consumption (FAO 2022a).

1.2. Challenges and safety concerns

Within Europe, the years spanning 2015 to 2020 saw the reporting of 2 473 food safety incidents linked to pesticide residues within fruit and vegetable categories (RASFF 2020; Pan et al. 2021). The issue of pesticide residues in agricultural produce remains a paramount concern for food safety (Niyaz & Demirbaş 2018). Paradoxically, while pesticides were initially introduced to bolster agricultural productivity, their indiscriminate usage over time has posed threats to human health and the sustainability of environmental practices. The inappropriate application of pesticides in terms of quantity, timing, and frequency jeopardizes not only environmental sustainability but also human well-being. Moreover, the excessive utilization of pesticides hampers the optimal allocation of natural and economic resources (FAO 2022b; WHO 2022).

1.3. Turkey's agricultural landscape

Turkey has recently emerged as a formidable player in global agricultural production, securing a spot among the top ten nations (FAO 2022b). In 2020, Turkey was ranked 12th worldwide in terms of pesticide consumption, utilizing a substantial 53 672 tons. The distribution of plant protection products in the same year encompassed fungicides (38.4%, 20 600 tons), herbicides (24.7%, 13 250 tons), insecticides (23.1%, 12 437 tons), plant activators (9.3%), and other groups such as plant growth regulators, insect attractants, fumigants, acaricides (4.0%, 4 995 tons), and rodenticides and molluscicides (0.5%, 280 tons) (TRAFM 2022).

1.4. Pesticide usage in fruit and vegetable production

The application of pesticide residues finds its most intensive use in the production of fruits and vegetables on a global scale (Pan et al. 2021). This practice is particularly widespread in the cultivation of annual vegetables like tomatoes and peppers in Turkey (EURASIANET 2022).

1.5. The focus of the study

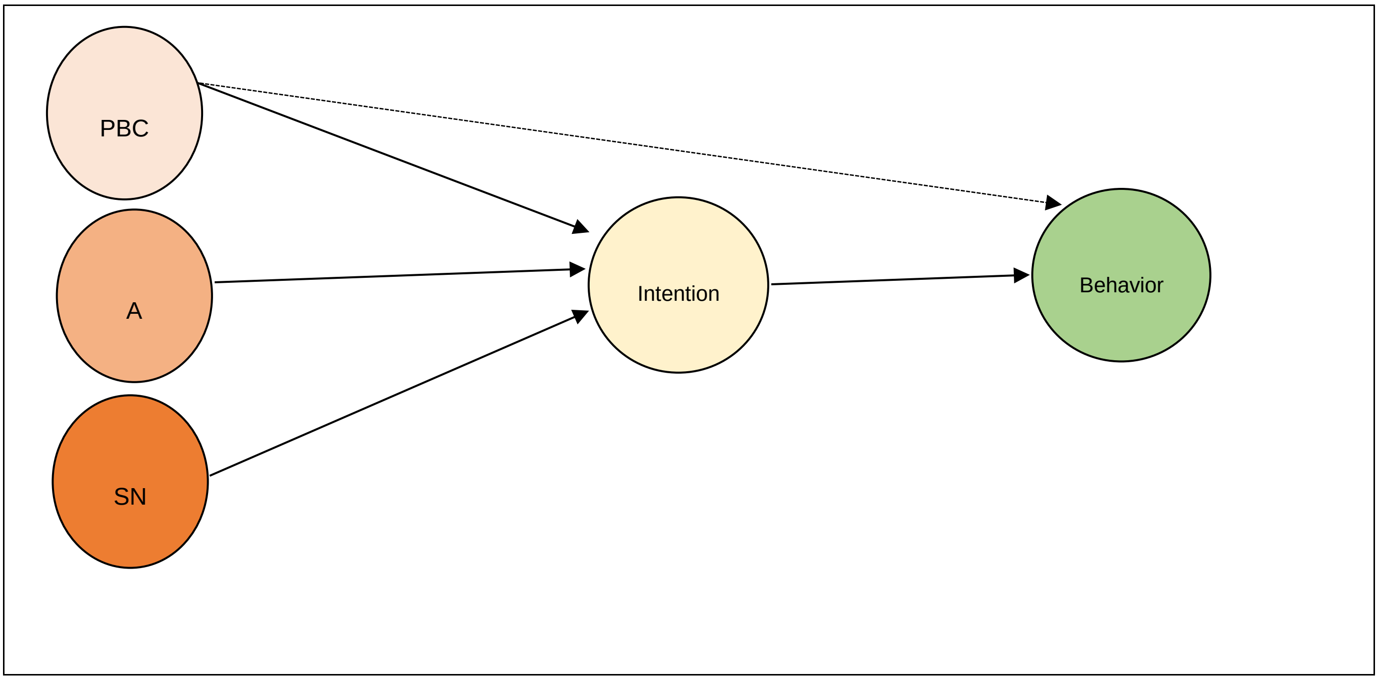
Turkey is a significant contributor to global pepper production, ranking third alongside China and Mexico. In 2019, the country's pepper production reached an impressive 2.59 million kg, contributing to 6.9% of the world's total pepper output. Diverse varieties of peppers, including table, dried, and canned types, thrive in Turkey (FAO 2022a). The present study aims to understand the determinants that shape pesticide use intentions and behaviors among Capia pepper farmers in Turkey. Positioned within the framework of the Theory of Planned Behavior (TPB), this study holds significance in the realm of world pepper production due to its unique focus on pesticide utilization. Central to this investigation is the fundamental inquiry: "What factors influence the pesticide use intentions and behaviors of Capia pepper farmers in Turkey?"

2. Previous Studies and Theoretical Background

The use of pesticides is applied by farmers producing agricultural products to combat organisms that harm the development of agricultural plants (Rezaei et al. 2020; Ataei et al. 2021; Damalas 2021; Lou et al. 2021). It is important to use pesticides for agricultural purposes at the optimum dose. Accordingly, the final actors that are effective in deciding the type and amount of pesticide use are farmers (Bakker et al. 2021; Govindharaj et al. 2021; Wang and Liu 2021). Agricultural pesticide residues and related problems mainly stem from farmers' pesticide use behavior. Therefore, it is necessary to explain the behavior of farmers when using pesticides and the factors that influence this behavior. Within the framework of behavioral economics, there are many behavioral theories designed to understand human behavior in the literature (Kwon & Silva 2019). TPB is one of the most frequently studied models on the pesticide use behavior of farmers (Beedell & Rehman 2000; Colémont & Broucke 2008; Fan et al. 2015; Asadollahpour et al. 2016; Wang et al. 2017; Rezaei et al. 2018; Bagheri et al. 2019; Despotovic et al. 2019; Farani et al. 2019; Rezaei et al. 2019a; Rezaei et al. 2019b; Yazdanpanah et al. 2019; Kahramanoğlu et al. 2020; Savari & Gharechaee 2020; Ataei et al. 2021; Bagheri et al. 2021a; Bagheri et al. 2021b; Damalas 2021; Govindharaj et al. 2021; Imani et al. 2021; Lou et al. 2021; Semuroh & Sumin 2021; Tama et al. 2021). Somewhat akin similar to this study, only Çakırlı Akyüz & Theuvsen (2020) modeled the organic farming intentions of grape farmers in Turkey with TPB. Contrary to the international literature, no study has been found in which the direct pesticide use intention and behavior of farmers in Turkey's field has been theoretically examined within the framework of the Planned Behavior Theory.

TPB (Figure 1) was produced and developed by Ajzen in 1991 (Ajzen 1991; Ajzen 2002). It is a social-psychological theory that links intention and behavior. Accordingly, three main factors affect people's intentions and behaviors. These are Perceived Behavior Control (PBC), Subjective Norms (SN) and Attitudes (A). PBC refers to the perception of individuals' skills and possibilities, whether they are under their control or not (Ajzen 1991; Ajzen 2002; Damalas 2021). According to the TPB, PBC can be expected to affect both intention and behavior. Subjective norms are defined as the effect of the thoughts of people they care about on the attitudes and behaviors of individuals (Ajzen 1991; Ajzen 2002; Fan et al. 2015; Rezaei et al. 2018; Tama et al. 2021). Accordingly, the attitude of the people around can be a guide for any behavior of the individual. Subjective norms are expected to have a direct effect on an individual's intention and indirectly on his behavior. Attitudes, for if behavior is perceived as positive, it increases the probability of that behavior is implemented. Attitudes are expected to have a direct effect on the individual's intention and indirectly on his behavior (Ajzen 1991; Ajzen 2002; Asadollahpour et al. 2016; Pahang et al. 2021).

Figure 1- Theory of Planned Behavior Structure (Ajzen, 1991, 2002)



3. Material and Methods

This study utilized both primary and secondary data sources. The primary data consisted of a questionnaire specifically designed for the purpose of this study. Secondary data were collected from official statistical sources and macro reports. The primary data for the study were gathered through face-to-face surveys conducted with Capia pepper farmers.

3.1. Research design, questionnaire, variables, and scale

This research employed a quantitative approach to investigate the pesticide use behavior related to the TPB among Capia pepper farmers. A structured questionnaire was developed and administered between February & March 2020. The questionnaire was constructed based on previous research on pesticide use behavior and TPB applications (Ajzen 2002; Cheah & Phau 2011; Yadav & Pathak 2016; Kim et al. 2017; Farani et al. 2019; Savari & Gharechaee 2020; Ataei et. al. 2021).

The data collected from the structured questionnaires included information about the socio-demographic characteristics of Capia pepper farmers and contextual variables related to their pesticide use behaviors. To measure TPB-related items, a 5-Point Likert Scale (ranging from 5=strongly agree to 1=strongly disagree) was employed, consistent with previous studies in the field.

To assess the reliability and validity of the items on the 5-Point Likert Scale, a Reliability Analysis was conducted. Reliability Analysis is a method used to evaluate the consistency of responses to survey questions, providing insights into the reliability and validity of the collected data (Eisinga et al. 2012). In this study, the Cronbach's Alpha for the seventeen items used was calculated as 0.702, indicating high reliability for the entire scale used in the research.

3.2. Research area

Çanakkale holds a significant position in various economic sectors in Turkey, including agriculture and logistics, due to its strategic location. The province connects Asia and Europe, and its unique geographical and climatic characteristics contribute to a wide range of agricultural products. Çanakkale ranks among the top ten provinces in Turkey for the production of over forty agricultural products, notably leading in Capia peppers, peaches, and nectarine production (Çanakkale Commodity Exchange 2022).

Çanakkale province ranks 1st in Capia pepper production in Turkey, accounting for approximately 20.0% of the national total in 2018. Capia pepper represents 94.0% of the total pepper production in Çanakkale (TSI 2018; TSI 2020). According to 2018 data from the Turkish Statistical Institute (TSI), Çanakkale (218 591 Tons) is ranked first Turkey's Capia pepper production for tomato paste (1 128 060 Tons).

3.3. Sampling

According to data gathered by the Çanakkale Provincial Directorate of Agriculture and Forestry, the Yenice district accounts for 60.0% of Çanakkale province's entire Capia pepper production. For this reason, the research was carried out in the Yenice district of Çanakkale province (Çanakkale Provincial Directorate of Agriculture and Forestry 2019). The number of farmers who are members of the Chamber, producing Capia pepper in the Yenice district of Çanakkale, was determined to be 841. The sampling formula was taken into account over this number. According to the results of the Proportional Sampling formula, it was decided to conduct a face-to-face survey with 206 Capia pepper producers in the Yenice district. 90% confidence interval for 0.05 margin of error,

$1.645\ \sigma_p = 0.05 \quad \sigma_p = 0.03039$

$$n = \frac{N.p\ (1-p)}{(N-1)\ \sigma^2{}_{p_x} + p\ (1-p)} \quad (Yamane, 2010). \tag{1}$$

$$n = \frac{841\ (0.5)(0.5)}{840\ (0.03039)^2 + (0.5)(0.5)} = 206$$

Due to the inadequacy of data from the Çanakkale Provincial Directorate of Agriculture and Forestry, data from the Yenice Chamber of Agriculture were used to determine the total number of Capia pepper producers in the Yenice district and other information from village to village. Accordingly, there are 7 548 farmers and 841 Capia pepper producers in the Yenice district. When determining the villages where the surveys were to be conducted, villages with 30 or more Capia pepper producers were selected. Accordingly, the distribution of the 12 villages where the survey was conducted and the proportional distribution of the surveys according to the data are given by Yenice Chamber of Agriculture 2019.

3.4. Structural equation modeling

This study aimed to elucidate the pesticide use behaviors of Capia pepper producers in Çanakkale, the leading region in Capia pepper production in Turkey. This was achieved through the application of Structural Equation Modeling (SEM) within the framework of the TPB.

SEM is a robust statistical method for testing models that involve concurrent causal and reciprocal relationships between observable and latent variables. It allows for a comprehensive evaluation and quantification of significant theories. SEM is particularly useful for modeling interactions between theoretical constructs, accounting for measurement errors and relationships between errors, making it distinct from simple regression analysis (Hwang et al. 2020). SEM comprises two fundamental components: the Structural Model and the Measurement Model. The measurement model estimates latent variables using observable variables, displaying the relationships between latent variables and observable ones. In contrast, the structural model assesses relationships between latent variables. In this study, the SEM was created to test hypotheses (H_1, H_2, H_3, H_4, H_5) regarding the factors affecting pesticide use behaviors and intentions among Capia pepper producers within the TPB framework. In the course of the research, hypotheses (H_1, H_2, H_3, H_4, H_5) were examined using the model.

H_1= Intention affects behavior (Ajzen 2002; Bagheri et al. 2021b).
H_2= PBC is effective on behaviors (Ajzen 2002; Farani et al. 2019; Bagheri et al. 2021b).
H_3= PBC affects intention (Ajzen, 2002; Yazdanpanah et al. 2019; Savari and Gharechaee 2020; Ataei et al. 2021; Damalas 2021; Semuroh & Sumin 2021).
H_4= Subjective Norms are effective on intention (Ajzen 2002; Yazdanpanah et al. 2019; Savari & Gharechaee 2020; Ataei et al. 2021; Damalas 2021; Semuroh & Sumin 2021).
H_5= Attitudes have an impact on intention (Ajzen 2002; Yazdanpanah et al. 2019; Savari & Gharechaee 2020; Ataei et al. 2021; Damalas 2021; Semuroh & Sumin 2021).

In the SEM, which will be based on the Planned Behavior Theory, the factors that are expected to have an indirect or direct effect on both pesticide use intention and pesticide use behavior will be included (Rezaei et al. 2018; Bagheri et al. 2019; Despotovic et al. 2019; Farani et al. 2019; Rezaei et al. 2019a; Rezaei et al. 2019b; Yazdanpanah et al. 2019). Firstly, within the framework of the Planned Behavior Theory, the Intent factor is calculated with the following formula;

$$I = w_A\, A + w_{SN}\, SN + w_{PBS} PBS \tag{2}$$

The calculation of the three basic factors in the formula is as follows:

$$A = \sum_{i=1}^{n} b_i\ e_i \tag{3}$$

$$SN = \sum_{i=1}^{n} n_i \, m_i \tag{4}$$

$$PBC = \sum_{i=1}^{n} c_i \; p_i \tag{5}$$

Behavior is defined by the formula below. The effect of intention and PBC variables on the behavior variable is tested in this way.

$$B = w_ι I + w_{PBC} PBC \tag{6}$$

b, n, c= the strength of every item about an outcome or quality,
m, p= evaluation of the result and the characteristic
B= Behaviors, I= Intentions, A= Attitudes, SN= Subjective Norms,
PBC= Perceived Behavior Control
w= empirically derived coefficient (Ajzen 1991; Ajzen 2002; Damalas 2021; Govindharaj et al. 2021; Lou et al. 2021).

4. Results

4.1. Demographics and background variables

The demographic characteristics of Capia pepper farmers are given in Table 1. Accordingly, 99.5% of the surveyed farmers are male. As part of the research, the survey participants' ages were asked for and subsequently categorized into specific age groups. According to the data obtained, the average age of the farmers was 46.3 years, and the standard deviation was calculated as 10.7 years. In addition, the youngest farmer was 20 years old with the oldest farmer being 72 years old. Table 1 displays the distribution of Capia pepper producers in the research categorized by age groups. According to this, 7.8% of Capia pepper producers are between 20 and 30 years old, 23.3% are between 31 and 40 years old, 35.4% are between 41 and 50 years old, and 24.3% are between 51 and 60 years old and 9.2% are over 61 years old. Considering the distribution of Capia pepper producers within the scope of the research according to their educational status, it is seen that 61.6% of Capia pepper producers are primary school graduates, 19.4% are middle school graduates, and 13.6% are high school graduates with only 5.4% being university graduates. The number of people living in the households of Capia pepper producers in the research region was requested to be constantly variable and then grouped. While the average number of people in the households of the farmers was calculated as 3.4, the standard deviation was calculated as 1. The number of people living in the households of the farmers was determined as at least 1 and at most 6. So, 24.3% of the farmers live in households with 1-2 persons, 64.6% in households with 3-4 persons and 11.2% in households with 5-6 persons. More than half of the Capia pepper farmers, 54.9% have been farming for 25 years or less, and 45.1% have been farming for more than 25 years. More than three-quarters of the farmers (75.7%) have social security. Again, the majority of Capia pepper farmers (70.9%) are members of at least one agricultural cooperative. Finally, 42.7% of the farmers have non-agricultural income (rent, earned from other jobs, etc.).

Table 1- Demographics of Capia farmers

Variables	***Total (n)***	***(%)***
	206	100.0
Gender		
Male	205	99.5
Female	1	0.5
Age Groups		
20-30 years	16	7.8
31-40 years	48	23.3
41-50 years	73	35.4
51-60 years	50	24.3
61 and up	19	9.2
Descriptive statistics of age= Min.=20, Max=72, Mean= 46,3, Standart Deviation (S.D.)=10,7		
Education groups		
Primary school graduate (5 years)	127	61.6
Secondary school graduate (6-8 years)	40	19.4
High school graduate (9-11 years)	28	13.6
Graduated from a university (12 years and +)	11	5.4
Number of households groups		
1-2 person	50	24.3
3-4 person	133	64.6
5-6 person	23	11.2
Descriptive statistics of household number= Min=1, Max= 6, Mean= 3,4, S.D.= 1,0		
Farming experience status		
3-25 years	113	54.9
More than 25 years	93	45.1
Descriptive statistics of farmin experience= Min=3, Max= 55, Mean= 25,5, S.D.= 11,6		
Farmers' social security status		
Yes	156	75.7
No	50	24.3
Farmers' cooperative membership status		
Member	146	70.9
Not member	60	29.1
Non-farm income status		
Yes	88	42.7
No	118	57.3

Table 2 presents the particulars of farmers with non-agricultural income. Interestingly, 83.0% of the research participants opted not to disclose their total annual income, encompassing both agricultural and non-agricultural earnings. Therefore, questions about income are reduced to annual non-agricultural income and income from Capia pepper farming. The average annual non-agricultural income of Capia pepper producers with non-agricultural income was calculated as $ 4 710.

Table 2-Annual non-farm income of Capia pepper farmers

Annual non-farm income	***N***	***(%)***
4 710 $* and less	49	57.0
Over 4 710 $	37	43.0
Total	86**	100.0

Descriptive statistics of annual non-farm income= Min=316.9 $, Max= 14,084.5 $, Mean= 4,710.9 $, S.D.= 2,301.9 $;
*: 1 American $= 5.68 Turkish Liras in 2019 (CBRT, 2022).**: Two producers could not state their annual non-farm income.

Table 3 provides information on the annual income of farmers from Capia pepper production in 2019. Accordingly, the annual average income of Capia pepper farmers from Capia pepper is around $11.302. 62.8 % of the farmers earn around this figure or below.

Table 3- Income of annual Capia pepper production

Income of annual capia pepper	***N***	***(%)***
11 302 $ and less	103	62.8
Over 11 302 $	61	37.2
Total	164*	100.0

Descriptive statistics of annual Capia pepper production income= Min=1 056.3 $, Max=35,211.3$, Mean= 11,302.99 $, S.D.=7,715.8 $: ***;** Forty-two producers could not state their annual Capia pepper income

Table 4 provides descriptive statistics pertaining to Capia pepper production among the participants included in the research. Accordingly, the average size of the land is 20.9 decares, the average number of parcels is 3.1 parcels, and the average Capia pepper yield per decare is 3 199.3 kg.

Table 4- Descriptive statistics for Capia pepper production within the research's scope

Descriptives	*Minimum*	*Maximum*	*Mean*	*S.D.*	*N*
Capia Pepper Produced Area (Ownership+Rent)	1 da	100 da	20.9 da	15.9 da	206
Number of Parcels Produced Capia Pepper	1 parcel	15 parcels	3.1 parcels	2.4 parcels	206
Capia Pepper Average Yield/Decare (da)	2 000 kg	5 000 kg	3 199.3 kg	715.2 kg	206

Worldwide, 40.0% of pesticides are used as to herbicides, 17.0% to insecticides, and 10.0% to fungicides in 2020 (EUROSTAT 2022). According to 2018 data, the average pesticide use in Turkey is 15 005 Tons. 38.0% of this is fungicides, 25.0% herbicides, 23.0% insecticides and 14.0% other pesticide groups (TSI 2020). According to the effect assessment on diseases and pests given in Table 5, 42.2% of the farmers find herbicides (herbicides) effective, while 30.6% consider them very effective. 35.0% of the farmers find fungicides less effective, 30.1% ineffective, 20.4% effective and 14.1% very effective. 41.7% of the farmers stated that they found pesticides very effective, 31.1% effective and 20.9% less effective.

Table 5- Assessment of the impact of pesticides employed by Capia pepper producers in the research on diseases and pests (%)

N=206	*Very Efficient (% 75-100)*	*Efficient (% 50-75)*	*Less Efficient (Less than % 50)*	*Not Efficient*
Herbicide	30.6	42.2	21.4	5.8
Fungicide	14.1	20.4	35.0	30.5
Insecticide	41.7	31.1	20.9	6.3

4.2. Data analysis

In this research, Partial Least Squares (PLS) software (Smart PLS 3.2.3) has been used for SEM to determine the measurement and structural model.

4.2.1. Measurement model

First, the relationship between the measurement model and the latent variables and their measurements will be explored. Table 6 suggests the results of the measurement model. The measurement model provides the conditions for validity and reliability. Cronbach Alfa (α), Composite Reliability (CR), and average Variance Extracted (AVE) must offer certain values for convergent validity. According to the related literature, Cronbach Alfa and AVE is above 0.55 while CR is above 0.70 for convergent validity (Hair et al. 2017). The measurement model results provide these criteria (Table 6).

Table 6- Measurement model results

Variables of measurement model	*Factor Loadings*	*Cronbach's α*	*CR*	*AVE*
Pesticide Use Behaviors (B) [a,b]		0.874	0.924	0.803
B1. I grow Capia peppers using heavy amounts of pesticides.	0.963			
B2. I often grow Capia peppers using pesticides.	0.958			
B3. I grow Capia peppers using the most effective pesticides.	0.750			
Pesticide Reduction Intention (I) [a,c,d,e,f]		0.894	0.925	0.755
I1. I would like to grow Capia peppers using fewer pesticides.	0.855			
I2. I would like to grow Capia peppers using pesticides less often (with less scheduling).	0.905			
I3. I would like to grow peppers using pesticides that are less dangerous and do the least harm to nature.	0.898			
I4. I would like to grow peppers using pesticides that are less dangerous and do the least harm to humans.	0.817			
Attitudes (A) [a,e,f,g]		0.878	0.906	0.617
A1. I believe that excessive use of pesticides pollutes the soil, water and air.	0.786			

Table 6 (Continue)- Measurement model results

Variables of measurement model	*Factor Loadings*	*Cronbach's α*	*CR*	*AVE*
A2. I believe that excessive use of pesticides adversely affects consumer health.	0.781			
A3. Excessive use of pesticides can affect my health. I believe it has a negative effect.	0.786			
A4. I feel guilty when I use more pesticides than necessary.	0.743			
A5. Today, I feel a moral obligation to use extensive pesticides.	0.823			
A6. I feel a moral obligation to use extensive pesticides for future generations.	0.792			
Subjective Norms (SN) [e,f,g]		0.604	0.740	0.589
SN1. Farmers around me try to use pesticides less.	0.812			
SN2. We talk to the farmers around me about the use of pesticides.	0.720			
Perceived Behavior Control (PBC) [e,f]		0.618	0.743	0.614
PBC1. I believe I can lower my pesticide use in Capia pepper if I want.	0.984			
PBC2. I can manage to use exactly as much (no more or less) pesticides as the pepper needs.	0.510			

References: [a]Ajzen 2002; [b]Farani et al. 2019; [c]Kim et al. 2017; [d]Yadav & Pathak 2016, [e]Savari & Gharechaee 2020; [f]Ataei et. al. 2021; [g]Cheah & Phau 2011

4.2.2. Structural model

After the validity and reliability of the measurement model are achieved, the structural model results are presented. A bootstrap resampling method based on 5 000 repetitions and 300 cases was employed to assess their significance (Hair et al. 2017).
Table 7 shows the result of the hypothesis tests and the SEM. H_2, H_4, and H_5 are supported, but H_1 and H_3 are not supported from the opposite side.

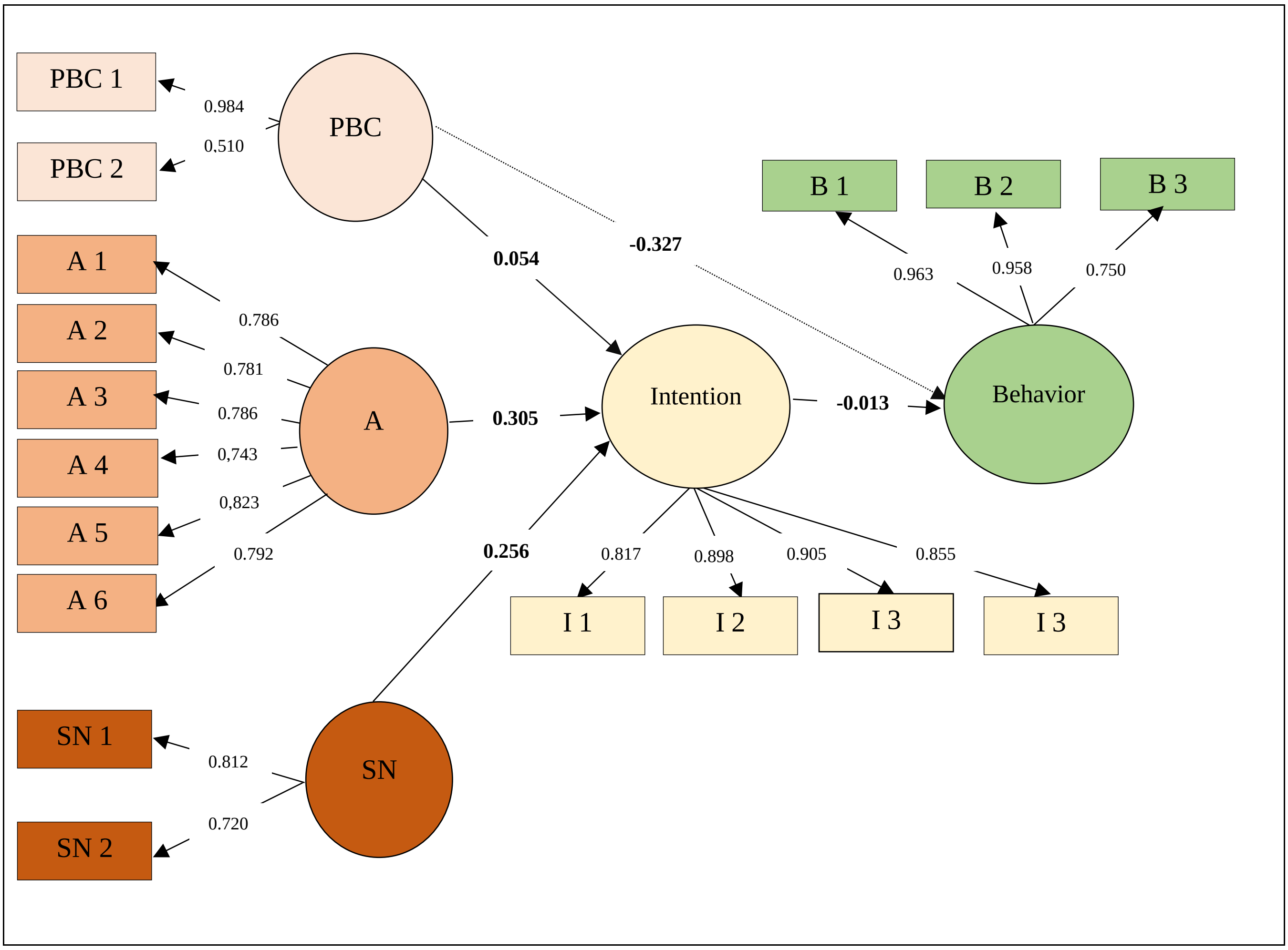
The Capia pepper pesticide use behavior is not influenced by the intention (H_1). This is because Capia pepper farmers generally refuse to believe that they use too much pesticide.
However, pesticide reduction intention is affected by attitudes and subjective norms (H_4, H_5). PCB has a negative effect on pesticide use behavior (H_2), while it is not effective on pesticide reduction intention (H_3).

Table 7- Structural model results

Hypothesis	*Regression Path*	*Path Coefficient*	*t-statistics*	*P values*	*Remarks*
H_1	I -> B	-0.013	0.182	0.856	Not supported
H_2	PBC -> B	-0.327	4.472	0.000*	Supported
H_3	PBC -> I	0.054	0.606	0.545	Not supported
H_4	SN -> I	0.256	3.496	0.000*	Supported
H_5	A-> I	0.305	3.086	0.002*	Supported

The visual diagram of the obtained SEM is given in Figure 2. Path coefficients between latent variables in Table 7 are shown schematically. Again, the schematic representation of the factor loadings of the latent variables, which are given in Table 6 and constitute the lantent variables, are provided.

Figure 2- Visual Results of SEM



5. Discussion

5.1. Reiterating the research problem

This study investigates the pesticide usage behavior and the intention to reduce pesticide use among Capia pepper farmers, employing the TPB framework. The research problem stems from the concern that pesticide residues in Turkey's fruit and vegetable exports have increased, as indicated by the Rapid Alert System for Food and Feed (RASSF) portal data, revealing a threefold rise compared to the previous year (RASSF 2022). The study addresses the critical issue of pesticide use in fruit and vegetable production and the discrepancies between farmers' intentions and actual behaviors in this regard.

5.2. Major findings

Intentions vs. Behaviors: Farmers generally expressed their intention to use fewer and less intensive pesticides. However, they did not acknowledge intensive pesticide usage in their behaviors. Notably, the intention to reduce pesticide use did not significantly translate into corresponding behavior. This discrepancy highlights a challenge in aligning farmers' intentions with their actual pesticide usage behaviors.

Perceived Behavioral Control (PBC): PBC, representing individuals' perceptions of their control over a behavior, was not statistically significant concerning the intention to reduce pesticide use. This suggests that farmers' perceptions of their abilities and possibilities in reducing pesticide use did not significantly influence their intentions in this study. However, PBC was found to be statistically significant regarding pesticide use behavior, indicating that farmers' perceived control over their actions affected their actual pesticide usage.

Subjective Norms and Attitudes: Subjective norms, reflecting the social pressure farmers felt regarding their intentions, played a significant role in influencing their pesticide reduction intentions. Farmers' attitudes towards pesticide use were also significant in shaping their intentions. Both subjective norms and attitudes appeared to be strong drivers of farmers' intentions to reduce pesticide use.

5.3. Explanatory power and contribution to literature

This study stands out in examining the interplay between intention and behavior in the context of pesticide use among Capia pepper farmers. While many previous studies have focused solely on modeling the intention to use pesticides, our research extends the TPB model to analyze the impact of intention on actual behavior. This distinction is critical as it provides insights into the challenges of translating intention into action in the context of pesticide use.

5.4. Meaning of the findings and their importance

The findings underscore the complexity of influencing farmers to reduce pesticide use in practice. Despite their expressed intention to use fewer and less intensive pesticides, farmers' actual behaviors do not align with these intentions. This suggests that interventions aimed at changing farmers' pesticide use behaviors may face barriers beyond their intentions. Understanding these barriers is vital for policymakers and agricultural extension services seeking to promote sustainable and responsible pesticide use.

5.6. Relating the findings to similar studies

Comparing our results to similar studies in the literature reveals both consistencies and discrepancies. For instance, subjective norms and attitudes consistently emerged as significant factors influencing intention across various studies (Savari & Gharechaee 2020; Bagheri et al. 2021b; Damalas 2021; Govindharaj et al. 2021). However, the significance of PBC varies, with some studies reporting it as significant (Savari & Gharechaee 2020; Bagheri et al. 2021b; Govindharaj et al. 2021) and others, including our study, not finding it significant concerning intention (Yazdanpanah et al. 2019; Ataei et al. 2021).

Furthermore, our research extends the analysis to behavior, highlighting the significance of PBC on pesticide use behavior, which aligns with findings from some previous studies (Farani et al., 2019; Bagheri et al., 2021b). However, the non-significant relationship between intention and behavior observed in our study contrasts with some prior research that found a significant association between these variables (Savari & Gharechaee 2020; Govindharaj et al. 2021).

5.7. Alternative explanations of the findings

The inconsistency in the significance of PBC and the non-significant relationship between intention and behavior in our study may suggest that factors beyond individual intention and perceived control play a role in shaping farmers' pesticide use behaviors. Possible alternative explanations may include external factors such as economic incentives, agricultural practices, and the availability of alternative pest management strategies. Further research is needed to explore these additional factors and their interactions with the TPB constructs.

In summary, this study provides valuable insights into the complexities of influencing pesticide use behaviors among Capia pepper farmers. It underscores the importance of considering not only farmers' intentions but also external factors that may impact their actual pesticide usage. Policymakers and agricultural extension services should take into account these findings when developing strategies to promote sustainable and responsible pesticide use in fruit and vegetable production.

6. Conclusions

This research aimed to examine the drivers of farmers' pesticide use intention and behaviors. It has shown that farmers' positive intentions to reduce pesticide use do not necessarily turn into behaviors. The research has also shown that SN and attitudes are important drivers of farmers' pesticide reduction intentions while PBC is effective on their behaviors.

No TPB modeling approach has been used before to measure Turkish farmers' intentions and behaviors toward pesticide use. For this reason, these results provide new information fully revealing the TPB model as a suitable method to explain the intention and behavior Cappia pepper farmers in the study area to use pesticides in an effective way.

The results provide novel information about Capia pepper farmers' intentions and behaviors to reduce pesticide use. The discovery of these new insights, derived from a compelling survey on the intentions and behaviors of Capia pepper farmers in the study area, gives rise to another significant finding: this study found TPB to be a sufficiently robust model to study pesticide use intentions and behavior in Capia pepper. The results will help future research investigate: "Why can't farmers' intent to reduce pesticides be a positive behavior?"

Greater efforts are needed to ensure agricultural policies that will increase the awareness of farmers on pesticide use behaviors. In this context, it is thought that agricultural extension implications involving leading farmers and campaigns and public service announcements targeting farmers' attitudes may be beneficial.

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