Evaluating Willingness to pay for agricultural insurance and determinants of agricultural insurance purchasing in Samsun province of Türkiye

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Abstract

The study focused on the farmers' potential risks, willingness to pay (WTP) for agricultural insurance, and factors affecting the purchasing of agricultural insurance associated with their farm types. The objectives of the study conducted in Samsun province of Türkiye are (i) to bring out the link between individually insurable risk and agricultural insurance purchase, (ii) to calculate the amount of farmers' willingness to pay for insurance policy, (iii) to explore the determinants of insurance policy purchasing, (iv) to examine the effects of farmers' communication level, social participation and information sources on the insurance purchasing, and (v) to reveal the relationship between amounts of purchased agricultural insurance and insurance premium. Farm operators' willingness to pay (WTP) for purchasing agricultural insurance were elicited by using the Contingent Valuation Method (CVM). Sensitivity of the farm operators to insurance premium changes explored by using Tobit models. Research results showed that 72.6% of farms had the insurable risk and 67.3% of these farms purchase insurance. Based on the logit analysis, risk exposure, land tenure, subsidy and agricultural insurance's awareness positively affected the purchasing insurance. CVM analysis explored that the average amount of WTP for agricultural insurance was 28% of the current insurance premium. The study suggests that revising the content of insurance policy, solving payment disputes and expanding the policy coverage may accelerate farmers' adoption to agricultural insurance. Decision makers and insurance company should consider not only WTP and elasticities of agricultural insurance demand, but also the farm type differentation when determining the subsidies number and insurance premium.

Keywords: *Agricultural insurance, Willingness to pay, Farmer mobility, Determinants of insurance purchase, Insurance demand.*

1. Introduction

Throughout the past century, the agricultural sector has become more critical in nourishing the world's population. Agricultural production faced with several risk and uncertainty that affects the farm viability and income variability. Many factors such as climate changes, policy changes etc. increase the risks and uncertainties in agricultural production resulting in instability

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of farmers' income. Developments experienced last two decades have transformed agricultural production systems from conventional ones to the more complex food system. Naturally, risks faced with farmers and other supply chain actors became more complex and in different structure. Enjolras *et al.* (2014) stated that the risks faced by farmers in developed countries were very different and more complex than past due to the changes in the structure of the organization of agricultural production and integration with the agro-food chain. Stabilizing the income and increasing the viability of farms requires implementing appropriate macro and micro level risk management strategies against risks. Insurance is one of the most effective risk management strategies to prevent negative outcomes of potential risks and uncertainties. Tok (2022) suggested that insurance against financial losses was one of the most important risk management strategy among farmers. Agricultural insurance aims to reduce the income instability in the agricultural sector and minimize the adverse effects of natural disasters such as droughts, hail etc. on the state budget, and help small farmers who face risks and uncertainties in production (İsel, 2010; Mishra, 1996). In the agricultural sector with a high reliance on natural conditions, ensuring stability highly depends on the proper functioning of the agricultural insurance programs and efficiency of implemented risk management strategies (Barnett and Mahul, 2007; Ramírez Román *et al.*, 2013; Wang *et al.*, 2011). Therefore, policy makers and sector stakeholders have made tremendous efforts to increase the rate of agricultural insurance uptake in the agricultural sector worldwide. The success of the policies and strategies developed to increase the rate of insurance uptake depends on directly the income level of the farmers, the willingness of the farmers to pay for the insurance policy, and whether the risk faced with is individually insurable. In this context, knowing the determinants of purchasing insurance policy is crucial for policy makers and supply chain actors of agricultural insurance. Up to now, several studies have been conducted focusing on the determinants of purchasing insurance policy for crop insurance (Makki and Somwaru, 2001; Torkamani, 2002; Sherrick *et al.*, 2004; Ginder and Spaulding, 2006; Hong, 2008; Ginder *et al.*, 2009; Gül Yavuz, 2010; Özcan, 2012; Feng *et al.*, 2013; Karthick and Mani, 2013; Oruç *et al.*, 2014; Aidoo *et al.*, 2014; Ghazanfar *et al.*, 2015; Aziz *et al.*, 2015; Tadesse *et al.*, 2015; Kızıloğlu, 2017; Sihem, 2019). On the other hand, some researches explored the influencing factors for adoption livestock insurance (Mohammed and Ortmann, 2005; Kandel and Timilsena, 2018; Singh and Channdel, 2019; Subedi *et al.*, 2021; Devkota *et al.*, 2021). Babalola (2014) revealed the determinants of poultry farmers' adoption of agricultural insurance. In many cases, it is assumed that purchasing agricultural insurance is highly depending on well-specified quantitative factors such as premium, probability of loss and size of compensation (Hsee and Kunreuther, 2000). However, several variables were identified as different determinants of purchasing agricultural insurance in previous studies. Based on the results of the previous studies, most previous studies focused on economic variables rather than social, psychological and emotional factors, when analyzing the determinants of insurance purchase decision. Up to now, the variables related to mobility of the farm operators in their business environent such as communication level, social participation and information sources has been ignored when analyzing the determinants of insurance purchase. Ulbinaite *et al.* (2013) classified the factors formed the insurance purchase decision into 5 different groups such as acceptability of insurance conditions, insurers' competence, monetary attitude towards insurance, the positivity of consumers' insurance experience the possibility to reduce the amount of premiums payable for insurance. They also stated that the consumers' monetary attitude towards insurance was the least significant factors, while that of insurers'' competent was the most significant factors. On the other dimension, different studies have been conducted focusing on the farmers' willingness to pay (WTP) for agricultural insurance and demand for agricultural insurance. Ali (2013), Kiran and Umesh (2015), Yakubu *et al.* (2016), Ellis (2017), King and Singh (2018), and Mutaqin and Usami (2019) elicited the amount of WTP for agricultural insurance. Afterwards, Kumar *et al.* (2018) examined the influencing factors on the willingness for adoption of livestock insurance among dairy farming. Some researchers also analyzed the agricultural insurance demand (Smith and Baquet, 1996; Akdemir *et al.*, 2001; McCarthy, 2003; Garrido and Zilberman, 2008; Kouame and Komenan, 2012; Tan *et al.*, 2012; McIntosh *et al.*, 2013; Zhang and Fan, 2016). Determinants of insurance policy purchasing behavior and willingness to pay vary depending on the farm type. Farm type also shapes both the policies and strategies developed by policy makers and the decisions and strategies of insurance companies supplied insurance policies to the market. The dissemination of agricultural insurance among farmers requires knowing the determinants of insurance policy purchasing behavior and determining the amount that the farmers are willing to pay for the insurance policy by farm type. Up to now, most previous studies related to agricultural insurance have adopted the average approach, and they ignored the requirement of performing risk analysis before making the individual decision to buy insurance policy. In literature, there has been limited information on WTP, insurance purchasing determinants and relationship between premium and insurance demand by farm type. Many previous researches also neglected individually insurable risk concept and the differences associated with the farm types. These information gap in the literature has motivated the research. The study, therefore, intended to reduce this information gap. The study tested the prior hypothesis of whether the insurance purchasing determinants, WTP and insurance demand elasticity varies by farm type, or not at first. Secondly, the study focused on the hypothesis of whether the variables of exposure of risk, attitude toward risk and degree of risk aversion as indicators for exploring individually insurable risk affect the agricultural insurance purchasing, or not. At the same time, the hypothesis of whether the variables of communication level, social participation and information sources that reflected the mobility of the farm operators around their business environment affect the agricultural insurance purchasing, or not. Eventually, the hypothesis of whether the government premium subsidy is sufficient to cover the gap between farmers' WTP and insurance premium was tested. For fulfilling the information gap on the WTP, insurance purchasing determinants and relationship between risk premium and insurance demand by farm type, the objectives of the study conducted in Samsun province of Türkiye are (i) to bring out the link between individually insurable risk and agricultural insurance purchase, (ii) to calculate the amount of farmers' willingness to pay for insurance policy, (iii) to explore the determinants of insurance policy purchasing, (iv) to examine the effects of farmers' communication level, social participation and information sources on the insurance purchasing, and (v) to reveal the relationship between amounts of purchased agricultural insurance and insurance premium.

2. Risk management and agricultural insurance system in Türkiye

Nowadays, the severity of agricultural risks and its adverse effects have been increasing gradually in Türkiye due to the climate change, technological advances, complexity in trade. On the other hand, changes in exchange rates is a very important market risk in agricultural production due to having high international connections in terms of agricultural input supply and product marketing. In addition, production and marketing risks are not independent of each other, and fluctuations in production at both national and international level also cause price fluctuations for agricultural products having low supply and demand elasticity (Karahan Uysal and Saner, 2019). Turkish farmers are also affected by human, institutional (political and relational) and financial risk increases, as in the rest of the world. In addition, farms that are not strong enough financially have difficulty in accessing risk mitigation tools and some other services offered by technology. Ağır *et al.* (2015) emphasized that risks associated with the credit use such as interest rate fluctuations and the inability to access credit are important financial risk for Turkish farmers. The level of financial risk often threatens the sustainability of the farms, as the turnover rate of capital, profit margin, and thus savings rates are low in the majority of agricultural farms in Türkiye (Bayramoğlu *et al.*, 2013). It would be possible for farmers to cope better with the increasing level of risks and uncertainties they face, only by providing flexibility, adapting to events that will have bad consequences, and having the ability to prepare plans to reduce risks. Up to now, policy makers have tended to increase farmers' resistance to risks and compensate the loss sourced by negative outcomes. However, today's policy makers prefer to increase the flexibility of farmers and the food system. Turkish government tends to adopt holistic approach that takes into account the interaction between risks and opportunity cost, farm level strategies and government policies rather than increasing farmers' resistance. Currently, risk management tools used in Türkiye can be classified into 10 different groups such as direct financial aid, support purchases, product diversification, diseases and pests control, using appropriate technology, using producer savings, farm reorganization, licensed warehousing, contracted production, futures markets.

Agricultural insurance, which is an effective risk transfer strategy that can be applied in situations where the damage is high and the probability of its occurrence is in the insurable range, technical protection measures are not sufficient and the necessary conditions for insurance such as data infrastructure are provided, is currently a generally accepted risk management strategy in the agricultural sector in Türkiye. Agricultural insurance practices in Türkiye first started in 1957 with the insurance of plant products against hail risk within the framework of the General Insurance Law. This was followed by animal life insurance in 1960, poultry insurance in 1984, aquaculture insurance in 1990 and frost insurance for vineyards in 1991. Before adopting the agricultural insurance pool model (AIP), which includes the cooperation of the state and the private sector, with the Agricultural Insurance Law No. 5363 enacted in 2005 in order to effectively eliminate the suffering of the producers from multiple risks, agricultural insurance was carried out by the private sector for a single risk in Türkiye (Karahan Uysal *et al*., 2020). In general, damage-based single or multiple-risk agricultural insurances are applied in Türkiye. Insurance premium support has been given to producers since 2006 within the framework of the newly established system. Nowadays, the agricultural insurance portfolio includes 8 different types of insurance such as crop insurance, greenhouse insurance, sheep and goat insurance, aquaculture insurance, village based drought insurance, cattle insurance, poultry insurance and beehives insurance. Standard crop insurance package covers quantity loss due to hail, storm whirlwind, fire, earthquake, landslide and flood, wild boar attack (for solely field crops, vegetables, strawberry and saplings), rain (for cotton) and birds (for sunflower). It covers also quality loss of fresh fruits/vegetables and cut flowers due to hail. In crop insurance, 50% of the premium is subsidized by the government. There is also frost package, in which 2/3 of the premium is subsidized by the government. Greenhouse insurance compensates the crop loss and costs of dismantling, removing, cleaning, transporting the salvage. Government subsidy rate for greenhouse insurance is 50%. Regarding the sheep and goat insurance, it covers deaths, compulsory slaughtering and abortion during any time in pregnancy period due to accident, poisoning, national disaster, sunstroke, fire, explosion, surgery, wild animal attack, snack and insect bites. There is government subsidy by 50% for sheep and goat insurance. Aquaculture insurance covers losses of cage and nets, product and direct damage due to deaths and material damages arising from storm, whirlwind, earthquake, flood, algae bloom, accident, fish transfer, theft. Government subsidy rate for aquaculture insurance premium is 50%. Village based drought insurance covers only wheat, barley, oat, rye, triticale, chickpea and green/red lentil and certificated seeds of these crops cultivated in non-irrigated areas. Losses directly sourced by drought, frost, hot wind, hot weather wave, excessive humidity, over precipitation, hail, storm, whirlwind, fire, landslide, flood, earthquake throughout the village are compensated in this insurance. The subsidy rate is 60% for village based drought insurance. Cattle insurance is provided for breeding, dairy and male fattening cattle and buffalos for death, obligatory slaughter, abortion and death of calf losses arising from diseases, pregnancy, accidents, wild animal attack, poisoning, national disaster, sunstroke, fire and explosion. Government provides premium subsidy by 50% for cattle insurance. In poultry case, insurance covers poultries grown in closed systems with bio-safety and hygiene measures as well as open and half open systems against losses sourced by death, killing and obligatory slaughter due to disease, accident, poisoning, generators/fans failure, natural disaster and fire or explosion. There is premium subsidy by 50% in poultry insurance. Beekeepers having modern hives have the option to benefit insurance by using the premium subsidy by 50% against storm, whirlwind, fire, landslide, earthquake, vehicle impact, flood, wild animal attack, transportation problems such as strike, overturning, burning etc. (AIP, 2022).

In Türkiye, the annual total premium payment and sum insured value have been approximately 2.5 billion Turkish Liras (TL) and 55 billion TL. Annual paid loss was 1.23 billion TL, while number of policies was 2.09 million. The share of state-supported agricultural insurances in the total premium production of the insurance sector in Türkiye was 3.37% in 2017, it decreased to 2.73% in 2019. The number of policies, sum insured and total premium increased by 39.09%, 95.84% and 56.67%, respectively during the time period of 2016-2019. Regarding the distribution of the sum insured, crop insurance had the largest share in agricultural insurance by 53,9%. Cattle insurance had the share by 22,2%, while that of greenhouse insurance was 16,5%. The share of crop insurance in total premium was 64% in 2019, while the percentages of insurance of cattle, greenhouse, sheep were 26%, 4,7% and 4,15%, respectively (AIP, 2019).

When glancing at the number of policies by crop type, it is clear that wheat has the biggest share by 35.6%. Barley, sunflower and hazelnut followed it with the share of 13.5%, 10.9% and 4.8, respectively. The percentage of maize was 3.1%, while that of paddy was 2.4. The main reasons of loss under the coverage of crop insurance were hail and frost with the share of 54.7% and 29.3%, respectively. In greenhouse insurance, the number of policies, sum insured and total premium increased by 47.37%, 184.2% and 152.08%, respectively between 2016 and 2019. Regarding the cattle insurance, the number of insured animals increased by 22.6% per year between 2016-2019, while that of number of policies and total premium were 45.75% and 36.6%, respectively. The top provinces were Konya (8.1%), İzmir (6.2%) and Samsun (4.4%) in terms of the number of insured animals. The main reasons of loss were death and compulsory slaughter with the share of 43.6% and 40%, respectively. Even if their share is smaller than that of crop insurance, cattle insurance and greenhouse insurance, similar trends were observed in sheep-goat insurance, beehives insurance and aquaculture insurance. Aquaculture and beehives insurance experienced decrease in the number of policies due to the effects of Covid-19 pandemic (AIP, 2019). The positive tendency of agricultural insurance uptake is corroborated with the results of previous studies conducted in Türkiye (Engürülü *et al.*, 2014; Karahan Uysal and Bektaş, 2014; Naseri and Saner, 2017).

3. Research area

3.1. *Research coverage*

The research was conducted in 16 different districts of Samsun province in Türkiye. Samsun extends along with the coast of the Black Sea. The Kızılırmak (Red River) is one of the longest rivers in Anatolia, and its fertile delta lies west part of Samsun. The Yeşilırmak (Green River) flows to the east part of Samsun. Samsun has a humid subtropical climate like most of the eastern Black Sea coast (Figure 1). About 62.213 farms in Samsun (MOAF, 2019). Based on the statistics related to farm type and its distribution in Samsun, it is evident that mixed farms dominate the agricultural structure in Samsun. Approximately, 70% of the total farm in Samsun is mixed farm. The share of farms having crop monoculture is 10%, while that of animal husbandry is 20%. Hazelnut, paddy and wheat are the most common crops in farms having crop monoculture. Cattle breeding, beekeeping and fish culture farming are prominent among livestock farms. Mixed farms typically grow crops such as paddy, wheat and maize; fruits

Figure 1 - Map of research area.

such as hazelnut, peach, and apple; and vegetables such as leek, pepper, cabbage, and tomato on their 3.20 hectares of farmland. Mixed farms conducted crop production mainly by combining cattle breeding. In a typical mixed farm, herd size is 10 cattle, on average.

Samsun has different farming types due to geographical location and diversity in production patterns. The cultivated area in Samsun constitutes 1.61% of the overall agricultural land in Türkiye. The share of the crop fields, fruit plants, and vegetable land in the total agricultural lands of Samsun is 58.66%, 31.39%, and 4.46%, respectively (Table 1). Samsun is the pioneer in the production of hazelnut, paddy and winter vegetable such as leek, cabbage etc. Samsun is the biggest winter vegetable producer in Türkiye. The order of Samsun in total production of hazelnut is second, while that of paddy is third in Türkiye. Similarly, Samsun is the important province in cattle breeding, aquaculture and beekeeping.

Farmers tend to buy agricultural insurance for crop production, greenhouse, aquaculture, beekeeping, and livestock in Samsun. Most common crops to be insured are hazelnut, paddy and wheat. Dairy and breeding insurance is more widespread than poultry insurance.

3.2. *Research data*

The research data were collected by interviewing farm operators in Samsun province. To have a more comprehensive understanding of the farmers' intention to purchase agricultural insurance and willingness to pay for it, this survey is carried out in all the 16 districts in Samsun (Figure 1). Three sets of slightly different questionnaires were administered to randomly selected operators during the data collection stage. The questionnaire was formed, including 302 questions divided into socio-economic characteristics, farm characteristics, awareness, perceptions, and preferences. The scale to elicit willingness to pay for agricultural insurance by using specially structured questions under scenario basis was developed in the study. Farm level research data for specialized livestock farms, beekeepers, greenhouse farms and mixed farms were collected from randomly selected

Table 1 - Distribution of agricultural land in Samsun and Türkiye.

	Samsun		*Türkiye*	
	Land (ha)	*%*	*Land (ha)*	*%*
Field crops	220.189	58.66	15435.979	66.53
Fallow land	20.575	5.48	3512.773	15.14
Fruits	117.831	31.39	3462.387	14.92
Vegetables	16.734	4.46	783.632	3.38
Ornamental plants	0.063	0.02	5.174	0.02
Total agricultural land	375.392	100.00	23199.946	100.00

farms. Simple random sampling was used to calculate optimum sample size for these farms. The sampling criterion for specialized livestock farms was the number of cattle, while that of beekeepers was active colony. For the greenhouse farms and mixed farms, farmland was used as sampling criterion. The target population of livestock farms was 422 specialized dairy and cattle breeding farms having cattle more than 100 head, while that of beekeeping was 399 beekeepers having active colony more than 30. The target population size for greenhouse farms and mixed farms having farmland more than 1 hectare were 475 and 21331, respectively. When calculating the optimum sample size by using simple random sampling, precision and confidence level were used as 10% and 95%, respectively. Based on the results of the optimum sample size calculations, research data were collected from randomly selected 25 specialized livestock farms, 41 beekeepers, 59 greenhouse operators, 77 mixed farm operators considering the production year of 2017-2018. Farm level research data were collected from all active aquaculture farms (21). The Turkish average values of the investigated variables were based on the results of the previous research and the documents of related institutions and organizations.

3.3. *Methodology*

The study used a two-stage procedure. In the first stage, the risk attitudes of sample farmers were elicited, and risks faced by the sample farms were identified and analyzed. Also, we examined the risks, whether insurable or not, in this stage. In the second stage, the farmers' preference to purchase agricultural insurance and influential factors behind the purchasing agricultural insurance was explored. The study also assessed the willingness to pay for agricultural insurance and revealed the relationship between the insurance premium and purchasing agricultural insurance in this stage.

3.3.1. *Eliciting the risk attitudes of operators and exploring the individually insurable risk*

When eliciting the risk attitudes of operators, the experimental gambling approach based on the hypothetical choices between certain and risky alternatives in a utility function framework was used. In the study, we adopted the equally likely certainty equivalent method suggested by Anderson and Dillon (1992); Hardaker *et al.* (1997). We offered a series of small-stakes 50-50 gambles, including a certain payoff and several risky choices with linearly increasing expected payoffs and risk to sample operators. The process was started by assigning the expected utility at two endpoint outcomes. After eliciting the certainty equivalents for the corresponding probability level, the sample operators were categorized into risk attitude groups based on the derived utility function. Regarding the risk aversion, the degree of risk aversion of sample operators was measured using the derived utility function of sample operators based on the von Neumann-Morgenstern utility theorem. Arrow Pratt's measure of absolute risk aversion was used to calculate the risk aversion coefficient. Absolute risk aversion coefficients were calculated by using the equation of $A(w) = -u''(w) / u'(w)$. Where, $A(w)$ was the absolute risk aversion coefficient, $u'(w)$ was the first derivative of the utility function and $u''(w)$ was the second derivative of the utility function (Arrow 1964; Pratt 1964).

To include the insurable risk concept when analyzing the preference to buy agricultural insurance, the variables of the occurrence frequency, the number of losses incurred, and the characteristics of the insurable risk such as definiteness, measurability, statistically predictability, lack of catastrophic exposure, and considerable loss exposure were considered. Based on the risk analysis results, the risk faced with sample farms was identified as an insurable risk when the incident was low, and the damage caused by the event was enormous. Otherwise, risks were categorized as uninsurable risks. If operators are faced with uninsurable risk, they will follow other risk management strategies, such as control strategies, etc., rather than insurance. Then the healthy insurance ratio was calculated for each type of farm by dividing the number of farms buying agricultural insurance by the total number of farms facing insurable risk due to removing the bias that occurred considering all farms.

3.3.2. *Exploring the influencing factors on purchasing agricultural insurance*

Influential factors in purchasing agricultural insurance were explored using the Logit model based on the characteristics of farms purchasing agricultural insurance and not purchasing agricultural insurance. The dependent variable of the model was the variable of buying agricultural insurance. Farmers who have insurable risk and purchase agricultural insurance are included in the model as "1", and farmers who have insured risk but do not purchase insurance are included as "0". Independent variables used in the Logit model were selected based on literature. The independent variables used in the model were the risk exposure, attitude towards risk, the degree of risk aversion, land ownership, government support, credit use, record-keeping, presence of income diversity, social participation level index, communication score, innovation level index, experience of operator, information level of operators on agricultural insurance, product

Table 2 - Dependent and independent variables for the Logit model.

Dependent Variable	
Purchasing agricultural insurance	Facing insurable risk with no purchasing insurance = 0, Facing insurable risk and purchasing insurance = 1
Independent Variables	
Land tenure	Owned = 1, Rent = 2 and Sharecropping = 3
Off farm income	Having off-farm income= 1, otherwise 0
Type of farms	Aquaculture=1, Livestock=2, Mixed=3, Under covered or greenhouse=4 and Beekeeper=5
Product diversity	Number of products on farm
Income diversity	0=no income outside the farm, 1= having income outside the farm
Record-keeping status	No records=0, having records=1
Credit use	No credit use=0, credit use=1
Communication score	Score produced by using operators' responses to related questions.
Innovation score	Score produced by using operators' responses to related questions.
Social participation level index	Score produced by using operators' responses to related questions.
Non-agricultural investment	No investment outside the farms=0, having investment outside the farms=1
Use of government subsidy	Benefiting from government subsidy=1, otherwise= 0
Awareness of government subsidy of agricultural insurance	Not aware=0, aware=1
Opinion on insurance coverage level	Insufficient=0, sufficient=1
Opinion on the adequacy of indemnity	Insufficient=0, Sufficient=1
The information source of agricultural insurance	Internet =1, insurance personal=2, commercial banks=3, Department of Food Agriculture and Livestock=4 and University=5
Exposure of risk	The number of losses incurred, ₺
Attitude towards risk	1=risk seeker, 0=risk averse
Degree of risk aversion	The absolute risk aversion coefficient
Liquidity	The ratio of current assets and current liabilities
Number of colonies	Unit
Age of operators	Year
Education level of operators	Year
Farming experience of operators	Year
Family size	Person
Profitability	Return on equity
Number of animals	Head
Working time at the farm	Hours
Total farming risk	Sum of the activity risk and financial risk, ₺

diversity, type of farms, insurance coverage, awareness of premiums subsidy, family size, age of operators, education level of operator, animal stock, non-agricultural investment, liquidity, return on equity, working time at the farm, adequacy of compensation, and the number of active colonies (Table 2).

Social participation level, innovation score, and communication score index were used to reflect the mobility of the farm operators in their business environment who are inclined to take out insurance, the status of following the mass media, and whether they are prone to implement the innovations. A scoring approach based on operators' responses to questions was adopted to calculate social participation level, innovation score, and communication score index. Sample operators were classified associated with the total social participation score. The social participation level was identified as low participation when the operators had 4-6 points, while farmers grouped as a medium and high when the total score of sample operators equaled 7-9 points and 10-12 points, respectively. The innovation score index was calculated by summing the individual scores obtained from the related questions. Innovation scores varied from 0 to 12. Similarly, the communication score was calculated based on operators' responses to related questions. Communication scores of sample operators ranged from 0 to 44.

Logit model parameters were estimated using the maximum likelihood method. Maximum-likelihood estimates of the parameters were obtained by Eviews 8.

The general form of the maximum likelihood function was as follows (Greene, 2004):

$$L(\mu,\sigma) = \sigma^{-n}(2\pi)^{-n/2} exp\left[-\frac{1}{2\sigma^2}\sum_{i=1}^{n}(\tau_i-\mu)^2\right]$$

Where μ represented the mean value, σ represented the standard deviation, n was the number of farms, and *exp* was an exponential function. The maximum likelihood estimator was as follows:

$$\theta = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Where θ represented the vector of unknown parameters, which maximizes the probability, x_i was the joint probability, which was the product of independent variables multiplied by marginal probability.

The Hosmer Lemeshow test was performed to understand how well the model fits the data (Hosmer *et al.*, 1989). If the p-value in the Hosmer-Lemeshow test was higher than 0.05, we concluded that the model fits the research data.

3.3.3. *WTP for agricultural insurance and the link between premium and WTP*

The study elicited operators' Willingness To Pay (WTP) for purchasing agricultural insurance using the Contingent Valuation Method (CVM). CVM is one of the well-known methods to elicit WTP (Carson *et al.*, 2001; Hanemann, 1984; Omilani *et al.*, 2019; Perman *et al.*, 2003). We created hypothetical scenarios for agricultural insurance based on the operators' responses to specifically designed survey questions. Sample operators answered how much money they were willing to pay for agricultural insurance for each scenario. After determining the value of WTP (Y_i^*), the relationship between the premium and WTP was analyzed using the Tobit model.

$$Y_i^* = X_i\beta + \varepsilon$$

In the study, Y_i^* was the latent variable reflected the WTP, and it is assumed that Y_i^* varied from Y_{i1} to Y_{i2}, depending on the response of sample operators. The farms' probability of WTP was as follows:

$$P_r(Y_{i1} \leq Y_i^* \leq Y_{i2})$$

We developed the Tobit model for all farm types, while the Tobit model was not created for aquaculture because all aquaculture farms had agricultural insurance.

4. Result and discussion

4.1. *Socio-economic characteristics of sample farms*

Characteristics of the sample farms are depicted in Table 3. In the research area, the difference between insured and uninsured farms was statistically insignificant in terms of age, agricultural experience, educational level, working time at

Table 3 - Socio-economic characteristics of sample farms.

	Mixed Farm		*Greenhouse*		*Livestock*		*Beekeeper*		*Aquaculture*
Variables	*Uninsured*	*Insured*	*Uninsured*	*Insured*	*Uninsured*	*Insured*	*Uninsured*	*Insured*	*Insured*
The age of the operator (year)	49.5 (11.7)	50.6 (11.4)	48.9 (10.4)	47.3 (10.1)	42.0 (8.0)	42.8 (10.7)	58.0 (8.2)	56.0 (9.8)	50.8 (12.0)
Education level of the operator (year)	7.1 (3.3)	6.5 (3.5)	6.8 (3.4)	5.6 (1.2)	7.7 (2.6)	9.3 (4.5)	7.3 (4.4)	9.8 (5.2)	12.8 (4.3)
Farming experience (year)	26.8 (13.7)	26.9 (13.1)	23.4 (11.3)	25.4 (9.7)	17.3 (9.3)	21.3 (10.8)	20.3 (12.0)	24.3 (14.2)	15.0 (9.0)
Working time at the farm (months)	9.0 (3.1)	8.3 (3.3)	10.0 (3.1)	9.3 (3.0)	11.8 (0.	11.0 (2.3)	7.5 (3.2)	6.6 (3.0)	9.1 (4.0)
Family size (person)	4.7 (2.1)	5.4 (2.1)	5.2 (2.7)	5.3 (2.6)	6.3 (2.5)	5.4 (1.9)	3.2 (1.2)	4.2 (2.1)	4.1 (1.7)
Labor force (AWU)	2.3 (1.4)	2.8* (1.1)	2.6 (1.3)	3.0 (1.1)	3.0 (1.2)	2.8 (1.3)	1.1 (0.6)	1.2 (0.8)	0.7 (1.0)
Farmland (ha)	9.1 (7.3)	11.3 (15.3)	4.9 (11.4)	10.9* (11.1)	4.8 (3.6)	12.7** (10.6)	1.6 (2.4)	1.8 (3.3)	-
Animal stock (head)	23.7 (29.7)	15.8 (18.5)	2.7 (4.2)	10.7** (16.4)	149.2 (84.9)	161.8 (86.7)	-	-	-
Number of a bee colony (number)	-	-	-	-	-	-	147.5 (78.2)	109.5 (115.0)	-
Fish production capacity (ton)	-	-	-	-	-	-	-	-	725.18 (673.4)
Social participation level	11.9 (4.6)	11.4 (3.3)	11.1 (3.8)	12.9 (3.9)	7.2 (1.3)	8.3 (1.6)	7.8 (1.3)	8.1 (1.2)	8.6 (0.5)
Communication score	7.7 (4.9)	9.6** (4.8)	7.6 (6.0)	9.7** (5.8)	14.3 (7.5)	17.8** (11.2)	19.0 (9.6)	25.4** (8.1)	29.1 (7.4)
Innovation score	4.9 (3.2)	3.7 (3.4)	3.4 (3.7)	5.0 (3.4)	2.2 (2.6)	5.4 (4.1)	4.2 (3.3)	4.0 (4.2)	8.9 (3.3)
Debt[1]	6.3 (13.0)	6.4 (5.0)	9.0 (5.5)	12.2 (10.3)	2.7* (5.6)	1.8 (6.0)	28.2 (40.4)	8.4 (10.3)	3.6 (5.7)
Equity[1]	163.9 * (204.2)	160.5 (239.5)	322.5*** (214.4)	172.5 (91.8)	13.0 (15.6)	20.7* (23.1)	326.1* (390.8)	339.8 (345.3)	9.7 (7.4)
Asset[1]	170.3 (214.6)	166.9 (239.9)	331.6*** (218.2)	184.8 (93.8)	15.7 (18.3)	22.5* (26.0)	354.2* (383.8)	348.2 (345.5)	13.2 (12.8)
Return on asset (%)	35.0* (109.0)	7.6 (10.4)	3.3 (4.0)	10.8 (33.4)	2.6 (12.0)	10.8** (31.3)	15.8 (21.5)	22.4 (37.9)	33.8 (46.6)
Return on equity (%)	3.3 (8.4)	0.9 (1.6)	3.4* (4.1)	11.6 (34.1)	3.1 (14.1)	11.7** (35.3)	17.1 (21.1)	22.9 (37.9)	46.5 (44.5)

****p<0,01, **p<0,05, *p<0,10; 1 Euro equals to 6,53 (₺) Turkish Liras in 2019 (CBRT, 2019).*

[1] Unit for capital structure variables in mixed farm and greenhouse farm were thousand ₺/ha, while units in the livestock farm, beekeeper, and aquaculture farms were thousand ₺/head, ₺/colony, and ₺/ton.

the farm, and family size for all types of farms ($p>0.10$). Similarly, all farm types' labor force values were the same, except for mixed farms. In mixed farms, insured farms had a higher labor force than that uninsured farms ($p<0.10$). There was no statistically significant difference between insured and uninsured farms in mixed farms and beekeeping regarding farmland. However, insured farms with greenhouse ($p<0.10$) and livestock ($p<0.05$) had higher farmland compared to uninsured ones. As expected, aquaculture farms did not have any farmland. Except for the greenhouse farm type, all farm types had nearly the same number of animal stock ($p<0.10$). Insured greenhouse farms had more animal stock than uninsured ones ($p<0.05$). The capacity of aquaculture farms had 725 tons, on average. The difference between insured and uninsured farms was statistically insignificant in terms of social participation level and innovation score for all types of farms ($p>0.10$). However, the communication score of insured farms was higher than that of uninsured farms in all farm types ($p<0.05$).

Uninsured livestock farms had more debt than that insured ones ($p<0.10$), while the difference between insured and uninsured farms was statistically insignificant for the other farm type ($p>0.05$). Insured mixed farms ($p<0.10$), greenhouse farms ($p<0.01$), and beekeepers had more equity and asset compared to uninsured farms ($p<0.10$), while the reverse was the case for livestock farms ($p>0.10$). Insured mixed farms ($p<0.10$) and uninsured livestock farms ($p<0.05$) gained more agricultural revenue and net profit per hectare compared to others. The uninsured mixed farm had a higher asset return than the insured ones ($p<0.10$). Similarly, uninsured livestock farms had a higher return on an asset than insured ones ($p<0.05$). The return on equity of uninsured greenhouse farms was more than insured ones ($p<0.10$). In insured livestock farms, the return on equity was higher than in uninsured farms ($p<0.05$).

4.2. *Risk attitudes, degrees of risk aversion, and risk facing with sample farms*

Based on the risk analysis results, it was clear that most sample operators were risk-averse and did not vary associated with farm type ($p>0.10$). The percentage of the risk-averse operator in mixed farms, greenhouse farms, specialized livestock farms, beekeeping, and aquaculture farms were 81.8%, 81.4%, 72%, 78%, and 57.1%, respectively. The highest percentage of risk seeker operators was observed in aquaculture farms and beekeepers (Table 4).

The highest risk aversion was measured in greenhouse farms in the research area. Beekeeper and aquaculture farms followed it. The operators of the mixed farms had the lowest risk aversion (Table 5).

The risk analysis results showed that the highest risk level was observed in livestock farms, while the smallest was observed in aquaculture farms. The risk level of mixed farms, greenhouse, livestock farms, beekeepers, and aqua-

Table 4 - The attitudes of the farmers the examined against the risk in terms of farms types.

	Mixed Farm		*Greenhouse*		*Livestock*		*Beekeeper*		*Aquaculture*	
	Frequency	*%*	*Frequency*	*%*	*Frequency*	*%*	*Frequency*	*%*	*Frequency*	*%*
Risk-averse	63.0	81.8	48.0	81.4	18.0	72.0	32.0	78.0	12.0	57.1
Risk seekers	14.0	18.2	11.0	18.6	7.0	28.0	9.0	22.0	9.0	42.9
Total	77.0	100.0	59.0	100.0	25.0	100.0	41.0	100.0	21.0	100.0

Table 5 - Risk aversion coefficient by farm type.

Risk aversion coefficient	*Mixed farm*	*Greenhouse*	*Livestock*	*Beekeepers*	*Aquaculture*
Mean	-0.000064	0.000701	-0.000015	0.000039	0.000019
Standard deviation	0.000376	0.003911	0.000047	0.000455	0.000913
Minimum	0.000249	0.021399	0.000044	0.001366	-0.000240
Maximum	-0.002360	-0.00070	-0.000170	-0.00125	0.000350

Table 6 - Risk level and risk exposure by farm type.

	Mixed		*Greenhouse*		*Livestock*		*Beekeeping*		*Aquaculture*	
	RL (%)	*RE (000 TL)*	*RL (%)*	*RE (000 TL)*	*RL (%)*	*RE (000 TL)*	*RL (%)*	*RE (000 TL)*	*RL (%)*	*RE (000 TL)*
Activities risk	13	189.8	13	243.1	27	874.8	16	51.74	3	254.7
Financial risk	-	-	3	54.3	-	-	3	9.7	-	-
Total risk	13	189.8	16	297.4	27	874.8	19	61.4	3	254.7

**RL is risk level, and RE is risk exposure.*

culture were 13%, 16%, 27%, 19%, and 3%, respectively. Regarding risk exposure, the highest risk exposure was in livestock farms. Greenhouse, aquaculture, and mixed farms followed it. The smallest one was in beekeeping (Table 6).

4.3. *The link between individually insurable risk and agricultural insurance purchase*

The study identified the factors behind purchasing agricultural insurance and explored the WTP for agricultural insurance. Research results showed that 72.6% of the total sample farms had an insurable risk, while that uninsurable risk was 27.4%. The percentage of operators facing with insurable risk and purchasing agricultural insurance was 67.3%. Whereas, ignoring the insurable risk, the percentage of operators purchasing agricultural insurance was 50.6%. This finding confirmed the results of previous studies. Based on the results of the previous research conducted in Türkiye, the ratio of purchasing agricultural insurance varied from 31% to 89.2%, and it was 52%, on average (Akçaöz *et al.*, 2006; Çukur *et al.*, 2008; Gül Yavuz, 2010; Kızıloğlu, 2017; Özcan, 2012; Pezikoğlu *et al.*, 2012; Tan *et al.*, 2012; Tümer *et al.*, 2010). Based on the research finding, it was clear that there was a bias of nearly 17% in each previous research due to not incorporating the individually insurable risk into the analysis. On the other hand, 31.1% of the sample farms facing with uninsurable risk purchased the agricultural insurance. Research results also showed that the ratio of buying insurance varied associated with farm type. The difference among farm types was statistically significant ($p<0.05$). The percentage of purchasing insurance for mixed farms, greenhouse, livestock, beekeeper, and aquaculture was 63.2%, 42.9%, 72.7%, 80.0%, 100.0%, respectively, when the insurable risk was considered (Table 7). Even though the greenhouse operator had the highest risk aversion among the sample farms, the smallest percentage was observed for the greenhouse due to lacking information and inadequate insurance policy coverage. The highest percentage was observed in aquaculture, beekeeping, and livestock. Unexpectedly, the rate of purchasing insurance in farms facing with uninsurable risk was higher than farms facing with insurable risk in the research area.

4.4. *Determinants of the agricultural insurance purchase*

Based on the results of Logit model, the log-likelihood value was -73.67 and it was statistically significant ($p<0.01$). The value of Mc

Table 7 - Preference for purchasing agricultural insurance in terms of individually insurable risk associated with farm type.

	Mixed Farm		*Greenhouse*		*Livestock*		*Beekeeper*		*Aquaculture*		*Total*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Insured	50.0	64.9	17.0	28.8	18.0	72.0	9.0	22.0	18.0	85.7	112	50.2
Uninsured	27.0	35.1	42.0	71.2	7.0	28.0	32.0	78.0	3.0	14.3	111	49.8
Total	*77.0*	*100.0*	*59.0*	*100.0*	*25.0*	*100.0*	*41.0*	*100.0*	*21.0*	*100.0*	*223*	*100.0*
Insured	36.0	63.2	15.0	42.9	16.0	72.7	24.0	80.0	18.0	100.0	109	67.3
Uninsured	21.0	36.8	20.0	57.1	6.0	27.3	6.0	20.0	0.0	0.0	53	32.7
Total number of farms having insurable risk	*57.0*	*100.0*	*35.0*	*100.0*	*22.0*	*100.0*	*30.0*	*100.0*	*18.0*	*100.0*	*162*	*100.0*
Insured	14.0	70.0	2.0	8.3	2.0	66.7	1.0	9.1	0.0	0.0	19	31.1
Uninsured	6.0	30.0	22.0	91.7	1.0	33.3	10.0	90.9	3.0	100.0	42	68.9
Total number of farms having uninsurable risk	*20.0*	*100.0*	*24.0*	*100.0*	*3.0*	*100.0*	*11.0*	*100.0*	*3.0*	*100.0*	*61*	*100.0*

Fadden Pseudo R^2 was 0.34. The Hosmer-Lemeshow goodness of fit test showed that the estimated logit model agreed well ($p<0.01$). Based on the estimated parameters, it was clear that risk exposure, land tenure, government subsidy, income diversity, social participation level index, communication score, farming experience, and awareness of agricultural insurance positively affected the of insurance purchase. The most important positive influential factor was government subsidy. Farms that benefited from government subsidies were 5.6 times more likely to purchase agricultural insurance than farms that did not benefit from government subsidies ($p<0.01$). Similar results were reported in some previous research. Aidoo *et al.* (2014) suggested that a government subsidy was required since farmers preferred low premiums, which are likely not feasible from the perspective of private insurance providers. Enjolras *et al.* (2012) stated that insurance tends to be costlier and less profitable to the insurance companies without government subsidy. Sihem (2019) also pointed out that government subsidies positively affected the purchasing of agricultural insurance. Income diversity was the second important factor that positively impacted the purchasing of agricultural insurance. Having an alternative income source increased the probability of purchasing agricultural insurance ($p<0.01$). The probability of purchasing agricultural insurance for the operator having alternative income sources was 2.85 times higher than that of the operator who had no alternative income sources. This finding confirmed the results of previous research conducted by (Feng *et al.*, 2013; Mohammed and Ortmann, 2005; Sherrick *et al.*, 2004; Yakubu *et al.*, 2016). Regarding the the variables related to mobility of the farmers around their business environment, it was clear that there was a positive relationship between mobility of the farm operators and insurance purchase based on the sign of communication score variable. The intensity of the communication with actors in their business environment of farms increased the probability of purchasing agricultural insurance ($p<0.05$). The farms having effective communication with their social environment were 1.1 times more likely to purchase agricultural insurance than that farms having poor communication. Sign

Table 8 - Logit model results: factors affecting purchasing agricultural insurance.

Variables	*β*	*SE*	*Odds ratio*
Constant	-1.8598	1.7614	
Risk exposure	0.0002	0.0001	1.0020
Attitude towards risk	-1.3415**	0.5506	0.2615
Land tenure	0.3284	0.3927	1.3887
Government subsidy	1.7293***	0.4977	5.6367
Income diversity	1.0469***	0.3803	2.8488
Social participation level	0.0529	0.0692	1.0543
Communication score	0.0988**	0.0348	1.1038
Farming experience (year)	0.0199	0.0176	1.0201
Total farming risk (%)	-9.3131	10.3989	0.0001
Awareness of agricultural insurance	0.2579*	0.1576	1.2942
Product diversity	-0.3060**	0.1332	0.7364
Farm type	-0.4442*	0.2767	0.6413
Log likelihood	-73.6730		
Log likelihood ratio (X^2)	76.8384 ***		
Hosmer-Lemeshow	1.420 ***		
Mc Fadden Pseudo R^2	0.34275		

****p<0.01, **p<0.05, *p<0.10, 1; Euro equals to 6,53 (₺) Turkish Liras in 2019 (CBRT, 2019).*

of the coefficient of social participation level, which was another indicator of the mobility of the farm operators, was positive, but it was statistically insignificant. These results confirmed the research hypothesis of the mobility of the farmers around their business environment affect the agricultural insurance purchase. Oruç *et al.* (2014) and İpekçioğlu *et al.* (2011) stated that the farmers having positive attitude to insurance were socially more active, volunteer to implement innovations, had much more contact with the MoAF staff and used the mass media much more than other farmers. Awareness of agricultural insurance was another variable that positively affected agricultural insurance purchasing ($p<0.10$). The finding of an existing positive relationship between awareness of agricultural insurance and insurance purchase corroborated with the results of Aidoo *et al.* (2014), Ghazanfar *et al.* (2015), and Kiran and Umesh (2015). However, the variables of risk exposure, land tenure, social participation level index, and experience of the operators were statistically insignificant factors affected the agricultural insurance purchase ($p>0.10$) (Table 8).

The variables of risk attitudes, farm type, and product diversity negatively affected the agricultural insurance purchase ($p<0.10$). However, the variable of total farming risk was not statistically significant ($p>0.10$). The probability of purchasing agricultural insurance for risk-averse operators was 74% less than that of risk seekers. The finding confirmed the results of Aziz *et al.* (2015) and Torkamani (2002). However, Ginder and Spaulding (2006) and Smith and Baquet (1996) reported the reverse. Product diversity was one of the control strategies generally used in the research area. This strategy is why product diversity harmed agricultural insurance purchases. The probability of purchasing agricultural insurance for farmers who had more crops in the cropping pattern was 27% less likely than for others. This result corroborated with the results of previous research conducted by Enjolras *et al.* (2012); Mohammed and Ortmann (2005); Torkamani (2002).

In the research area, not only the probability of purchasing agricultural insurance but also influential factors varied associated with the farm type.

The results of logit analysis showed that the probability of purchasing agricultural insurance in beekeeping and greenhouse farms was 36% less than that of aquaculture and specialized livestock farms. These results confirmed the research hypothesis that the type of farms affected the agricultural insurance purchase. Similarly, this result corroborated with the results of Özcan (2012) (Table 8). When focusing on the influential factors on agricultural insurance purchase, it was clear that product diversity and the adequacy of indemnity were the main significant variables for beekeepers (Table 9). These findings confirmed the results of previous studies conducted by Aidoo *et al.* (2014); Ghazanfar *et al*. (2015); Kiran and Umesh (2015); Makki and Somwaru (2001); Torkamani (2002). For the mixed farms, risk exposure, the awareness of agricultural insurance and subsidy, degrees of risk aversion, number of animals, and working time at the farm were the determinants of purchasing agricultural insurance (Table 9). These results, except for the variable of working time at the farm, corroborated with the results of Aidoo *et al.* (2014); Enjolras *et al.* (2012); Ghazanfar *et al.* (2015); Kiran and Umesh (2015); Sherrick *et al.* (2004); Torkamani (2002). Land tenure, farming experience, operator education, number of animals, insurance coverage, and return on equity are determinants of purchasing insurance in greenhouse farms. These findings, except for the variables of return on equity and education level of the operator, confirmed the results of Aidoo *et al.* (2014); Enjolras *et al.* (2012); Feng *et al.* (2013); FAO (2005); Ghazanfar *et al.* (2015); Hong (2008); Karthick and Mani (2013); Kouame and Komenan (2012); McCarthy (2003); Sherrick *et al.* (2004); Torkamani (2002); Zhang and Fan (2016) reported that positive relationship between purchasing insurance and the variables of return equity and education level of the operator. However, the study suggested a negative relationship. When focusing on specialized livestock farms, the determinants of purchasing agricultural insurance were risk attitude, income diversity, insurance coverage, return on equity, and education level of the operator. The signs of risk attitudes, income diversity and the insurance coverage were different from

Table 9 - The direction of factors affecting an agricultural insurance use by farm type based on the results of Logit models in Türkiye.

Variables	*Mixed farms*	*Greenhouses*	*Livestock farms*	*Beekeeper*	*Previous literature**
Risk exposure (₺)	+				– [1] / + [2]
Attitude towards risk	-		-		- [1]
Land tenure		+			+ [1,3]
Awareness of agricultural insurance and government subsidy	+			+	+ [3,4,5]
Income diversity			+		– [6]/ +[2]
Farming experience (year)		+			+ [1,3,4,7]
Product diversity				-	-[1]
Number of animals	+	+			+[3]
Degree of risk-aversion	+				+[8]
Agricultural insurance coverage		+	-		+ [2,9,10,11]
Return on equity (%)		-	+		+ [8,12]
Working time at the farm (month/year)	-				Not available
Education level of the operator (year)		-	+		+[1,3,4,6,13]
The adequacy of indemnity				+	+ [14]
Log-likelihood	-20.0700	14.914	18.6162	6.2253	
Log likelihood ratio (X^2)	21.01675 **	35.538 ***	15.8209 ***	3.16439 **	
Hosmer-Lemeshow	51.77	49.33	19.47	17.05	
Mc Fadden Pseudo R^2	0.42	0.38	0.45	0.54	

** Previous literature of 1-14 was based on the results of Torkamani (2002), Sherrick et al. (2004), Aidoo et al. (2014), Ghazanfar et al. (2015), Kiran and Umesh (2015), Yakubu et al. (2016), Enjolras et al. (2012), FAO (2005), Shi (2008), McCarthy (2003), Smith and Baquet (1996) and Makki and Somwaru (2001), respectively.*

the results of Feng *et al*. (2013); FAO (2005); Hong (2008); Sherrick *et al.* (2004); Torkamani (2002); Yakubu *et al.* (2016), while the sign of return equity and education level of operator consistent with Aidoo *et al.* (2014); Enjolras *et al.* (2012); Ghazanfar *et al.* (2015); McCarthy (2003); Smith *et al.* (1994).

4.5. *WTP for agricultural insurance and the link between premium and WTP*

Based on the results of the CV, the amount of WTP for agricultural insurance in greenhouse farms was 38% of the current insurance premium. The ratio between WTP and current insurance premium in mixed farms, specialized livestock farms, and beekeeping were 31%, 29%, and 15%, respectively (Table 10). Similar results were reported by Ellis (2017), King and Singh (2018), Mutaqin and Usami (2019). King and Singh (2018) suggested that the WTP of Vietnam farmers was 30% of the current insurance premium. Ellis (2017) reported that farmers' WTP was lower than the current premium by 10%. Based on the results of Mutaqin and Usami (2019), WTP in the research area was lower than that of Japan. They stated that WTP for agricultural insurance is 83% of the current insurance premium in Japan. However, the results of Kiran and Umesh (2015) were not corroborated by the research finding. They suggested that the number of farmers' WTP for agricultural insurance was more than the current insurance premium rate by 14%. It was clear based on the upper evidence that premium subsidy was not cover the gap between amount of WTP and current premium. Government should increase the premium subsidy, which is currently 50% to enhance the insurance purchase among farmers. Similarly, Tok (2022) recommended to increase the insurance premium subsidy to 67%.

Table 10 - WTP for agricultural insurance and the link between premium and WTP.

	Premium (A)	*WTP for agricultural insurance (B)*	
	Value	*Value*	*B/A (%)*
Mixed farms (₺/ha)	1250.20	384.10	30.72
Greenhouse (₺/greenhouse)	771.01	292.75	37.97
Specialized livestock farms (₺/cattle)	176.19	51.58	29.28
Beekeeping (total colony)	87.85	13.04	14.85

Table 11 - Tobit model results: the relationship between amounts of purchased agricultural insurance and insurance premium.

Variables	*Coefficient*	*Standard error*	*t value*	*Marginal effect*	*Elasticity*
Mixed farms					
Constant	34.852***	2.905	12.000		
Insurance premium	-0.376***	0.048	-7.750	-0.366	-1.260
Log-likelihood function	-69.277				
LR (X^2)	29.73***				
Mc Fadden Pseudo R^2	0.177				
Greenhouse					
Constant	19.114***	2.687	7.110		
Insurance premium	-0.028***	0.007	-4.030	-0.268	-6.828
Log-likelihood function	-34.971				
LR (X^2)	10.71***				
Mc Fadden Pseudo R^2	0.133				
Specialized livestock farms					
Constant	14.488***	1.775	8.160		
Insurance premium	-0.141***	0.031	-4.570	-0.139	-0.781
Log-likelihood function	-23.561				
LR (X^2)	11.96***				
Mc Fadden Pseudo R^2	0.203				
Beekeeping					
Constant	18.200***	2.712	6.710		
Insurance premium	-0.402***	0.089	-4.500	-0.366	-1.058
Log-likelihood function	-37.179				
LR (X^2)	13.33***				
Mc Fadden Pseudo R^2	0.152				

****p<0.01, **p<0.05, *p<0.10.*

The results of the Tobit models associated with farm types showed that all estimated models were statistically significant ($p<0.01$). Expectedly, the coefficients reflected the relationship between amounts of purchased agricultural insurance and risk premium was negative and statistically significant ($p<0.01$) (Table 11). This finding confirmed the results of Ellis (2017), Kiran and Umesh (2015), Mutaqin and Usami (2019). The sensitivity of farm operators to changes in insurance premiums varied associated with the farm type. The greenhouse and mixed farms operators were the most sensitive to changes in insurance premiums. The sensitivity of the greenhouse and mixed farms depends on their tendency to use alternative risk control strategies. Beekeepers were indifferent to changes in insurance premiums. The least sensitive farm type to changes in insurance premium was specialized livestock farms in the research area due to the obligation of tying agricultural credit.

The elasticities that reflect the relative relationship between amounts of purchased agricultural insurance and risk premium explored that response of the farm operator to relative premium change varied by the farm type.

For the greenhouse, the demand for agricultural insurance was elastic. In greenhouse farms, an increase in insurance premium by 1% would cause a decrease in the amount of purchased insurance by 6.83%. When glancing at the mixed farms, the number of farmers would decrease by 4 if the insurance premium increased by 10 TL ($p<0.01$). An increase in insurance premium by 1% would cause a decrease in the amount of purchased insurance by 1.26%, resulting in agricultural insurance demand being elastic for mixed farms.

In specialized livestock farms, the number of farmers purchasing insurance would decrease by one farmer if the insurance premium was increased by 10 TL. Regarding relative changes, an increase in insurance premium by 1% would cause a decrease in the amount of purchased insurance by 0.78%, which meant that agricultural insurance demand was inelastic for specialized livestock farms. The number of beekeepers purchasing insurance would decrease by four if the insurance premium were increased by ₺10 ($p<0.01$). An increase in insurance premium by 1% would cause a decrease in the amount of purchased insurance by 1%, resulting in agricultural insurance demand being unitary for beekeeping. The results related to demand elasticities of insurance confirmed the research hypothesis of the insurance demand elasticity varies by farm type.

5. Conclusions

This study examined the farmers' potential risks associated with their farm types, their tendency to insure their business, willingness to pay for agricultural insurance, and factors affecting the purchasing of agricultural insurance. In addition, the study suggested new social variables as determinants of insurance purchase such as communication with business environment, social participation and information sources. Based on the evidence from the research results, it was clear that ignoring the incorporation of the insurable risk concept caused the incorrect estimation of the insurance rate. Researchers in the previous research and insurance firms and related public institutions in practical life calculated the insurance rate simply by dividing the number of farms covered by agricultural policy by the total number of farms, even if their risks are individually uninsurable. Naturally, farmers who were not covered by agricultural insurance policy were included directly in the uninsured group, resulting in reaching a lower insurance rate than ought to be; according to the research finding that there was a bias of approximately 17% due to not incorporating the insurable risk into the analysis. Developing education and extension programs focusing on risk management, especially insurable risk, and participation of the personal, expert, and decision-makers in insurance firms and related institutions in education programs may minimize the measurement bias in calculating insurance rates. It was clear based on the research findings that risk being individually insurable was important factor affecting the agricultural insurance purchasing.

The research area's prominent reasons for not purchasing agricultural insurance in the research area were lacking information, a high level of premium, inadequate indemnity, and small farm size. Research findings confirmed the hypothesis of the study that the rate of farms covered by agricultural insurance policy varies associated with farm type. It was clear from the research findings that high insurance premiums and insufficient coverage were the main reason for not purchasing insurance for specialized livestock farms, while that of greenhouse farms were insufficient coverage, lacking of information, and had small farmland. The study suggests that the insurance rate would increase if the dissemination of information related to agricultural insurance is provided by university extension services and personnel of the provincial/district directorate of the Ministry of Agriculture and Forestry. Cooperation of insurance firms with universities and provincial/district directorate of Agriculture may increase the efficiency of demonstrations and briefings considering changing insurance rates associated with farm type. In the research area, focusing on coverage of insurance in farmers' education programs for greenhouse farms may increase the success of the education programs since the government subsidies are the main drivers to increase insurance rate, not only WTP and elasticities of agricultural insurance demand but also the farm type differentiation should be considered by decision-makers and insurance company when determining the amount of subsidies and insurance premium. Due to the fact that government premium subsidy was insufficient for all farm types to cover the gap between farmers' WTP and insurance premium, decision-makers should create an alternative approach to determine the amount of insurance premium subsidies.

Under the light of research findings, greenhouse and mixed farms are the most sensitive farm-type to insurance premium change because they tend to follow risk control strategies such as chemical and cultural application, etc. It is challenging to increase the insurance rate without balancing the insurance premium and coverage by farm type in the research area. Therefore, insurance firms would not increase the insurance rate unless they revised the insurance coverage in the research area. When determining the insurance premium, the insurance firm should consider the research findings that the premium was very high for mixed farms and coverage was insufficient for specialized livestock farms. Farmers conducted their activities in the research area required three times premium installments and preferred to pay in April and September. Revising the insurance policy package and remedies for minimizing the negative effects of small farm scale may increase the insurance rate in the research area. In addition, policymakers should consider the WTP of sample farms and differentiation among farm types to increase the insurance rate. Increasing the quality of customer relationships of the insurance firm, improving expertise services, decreasing bureaucracy, and developing programs strengthened the belief that farmers may positively contribute to the dissemination of agricultural insurance. Enriching the insurable risk portfolio and extending insurance coverage may help increase the insurance rate.

Unlike previous studies, the study introduces variables of social participation and communication levels as two new social factors that affected the insurance purchase. The study showed that mobility of the farm operators in their business environment positively affected the insurance purchase. Based on the finding that having a high level of social participation level and strong communication with business environment increases the probability of purchasing insurance. The study suggests putting into practice some remedies such as providing subsidies to mobilize farmers, increasing the number of contacts of extension services, organizing social and cultural activities and enhancing the non-governmental organization (NGO) to strengthen the social participation and communication of farms. Following the results of social network analysis and concentrating on mobility of farm operators when organizing the all kinds of activities related to agricultural insurance may positively contribute the elamination the factors of hinder insurance purchase.

It would be of interest to confirm the validity of research results via increasing sample size and providing spatial differentation. An additional effort to explore the link between the quality of expertise service and problems related to insurance coverage and sufficiency of indemnity might offer a more precise analysis for determinants of insurance purchase. Further research should address associated with farm size.

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