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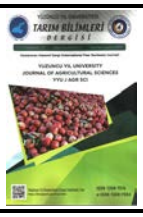

Research Article (Araştırma Makalesi)

Factors Affecting the Adoption of Innovations in Dairy Cattle Farms in TR22 South Marmara Region of Turkey

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Abstract: The present study was aimed to define the factors affecting the adoption of innovations in dairy cattle farms in Balıkesir and Çanakkale provinces in TR22 South Marmara Region, Turkey. The data were collected from 221 farms by a stratified random sampling method. The study was performed between March and November 2019. This study was used the ordered probit model to evaluate the data. The results revealed that the age of the farmers, household size, dairy cattle experience, household income, the number of dairy cattle, frequency of the internet use, meeting frequency with other farmers and contact frequency with agricultural extension personnel had a positive impact on farmers' adoption of innovations; whereas farmers' contact frequency with veterinaries had a negative impact. As a result, farmers' adoption of innovations in dairy farming activity can be increased with farmers who are open to innovations regarding animal husbandry and knowledgeable about the importance and the necessity of innovations adoption.

TR22 Güney Marmara Bölgesindeki Süt Sığırı İşletmelerinde Yeniliklerin Benimsenmesini Etkileyen Faktörler

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Anahtar kelimeler

Benimseme,
Süt sığırı,
Yenilik,
Sıralı probit analiz.

Öz: Bu çalışmada; Türkiye'nin TR22 Güney Marmara Bölgesindeki Balıkesir ve Çanakkale illerindeki süt sığırcılığı işletmelerinde, yeniliklerin benimsenmesini etkileyen faktörlerin belirlenmesi amaçlanmıştır. Veriler, tabakalı tesadüfi örnekleme yöntemi ile 221 süt sığırcılığı işletmesinden toplanmıştır. Çalışma Mart ve Kasım 2019 arasında gerçekleştirilmiştir. Çalışma verilerini değerlendirmek için sıralı probit model kullanılmıştır. Çiftçilerin yaşı, hane halkı büyüklüğü, çiftçilerin süt sığırcılığı deneyimi, hane halkı geliri, süt sığırı sayısı, internet kullanım sıklığı, diğer çiftçilerle görüşme sıklığı ve tarımsal yayım personeli ile iletişim sıklığı değişkenlerinin, çiftçilerin yenilikleri benimsemesi üzerinde olumlu etkisinin olduğunu ortaya koymuştur; oysa çiftçilerin veterinerler ile iletişim sıklığı olumsuz şekilde etkilemiştir. Sonuç olarak; süt sığırcılığı faaliyetinde çiftçilerin yenilikleri benimsemesi, hayvancılık faaliyeti ile ilgili yeniliklere açık olan ve yenilikleri benimsemenin önemi ve gerekliliği hakkında bilgi sahibi olan çiftçilerle artırılabilir.

1.Introduction

Livestock sector is an important in economics of a country. This sector is important in terms of providing adequate and balanced nutrition, providing cash flow to household and reducing unemployment in rural areas (Aksoy et al., 2011; Yener and Oğuz, 2017). Therefore, farmers' keeping up with these changes by following their new technologies or innovations and current developments is rather important in terms of sustainability of livestock activity. However, the level of adopting innovations depending on the standard of living, the society structure and the economic contribution of these innovations (Sezgin et al., 2010). Also, modernization efforts in animal husbandry start with advancement of technology in rural areas. Hence, farmers should be supported to use new technologies. In Turkey, TR22 South Marmara Region has an important place in regards to the number of livestock. According to the area classification of NTUS-2 (Nomenclature of Territorial Units for Statistics-2) by TURKSTAT (Turkish Statistical Institute), TR22 South Marmara Region covers the provinces of Balıkesir and Çanakkale. The region has about 5.41% of total bovine animal population of Turkey. In the region, there has been significant increases in culture breeds in animal population in recent years and the share of culture breeds was approximately 77.3% in 2019. Also, approximately 6.15% of total milk production of Turkey is provided from this region (TURKSTAT, 2019). Hence, it can be said that adoption to new technologies or innovations for the development of farms in research area is an important. In the literature, there are many studies about adoption of innovations (Kebede, 1990; Boz et al., 2011; Yener and Oğuz, 2017). However, there is no comprehensive study conducted in Balıkesir and Çanakkale provinces in TR22 South Marmara Region in relation to this subject. Also, it is thought to be an important determination of factors affecting farmers' decisions about innovations adoption for development of the dairy farming in the region. For this reason, this study was performed in TR22 South Marmara Region, which is one of the most important regions of Turkey in terms of dairy cattle activity. The purpose of the present study is to explain the factors affecting farmers' decisions about the adoption of innovations in dairy cattle farms in Balıkesir and Çanakkale provinces that cover of TR22 South Marmara Region. To explain the issues defined in the objective of the study, the following hypotheses were tested:

H_0=Communication behaviours, socio-economical and farm characteristics have no significant influence on farmers' adoption of innovations,

H_1=Communication behaviours, socio-economical and farm characteristics have a significant influence on farmers' adoption of innovations.

The results of this study are expected to make important contributions in terms of farmers' adopting innovations and providing useful information for agricultural extension organizations and other researchers.

2. Material and Methods

Research data was obtained from dairy cattle farms in Balıkesir and Çanakkale provinces in TR22 South Marmara Region through survey method between March and November 2019. The data were gathered by face-to-face interview technique. The number of animal in farms was taken into consideration for determining farms whose main income source is dairy farming in these districts. According to data of Republic of Turkey Ministry of Agriculture and Forestry, districts that are the most representative to provinces in terms of the number of animal were determined as Altıeylül district from Balıkesir province, and Biga district from Çanakkale province. The number of farms in these districts was constituted the target population of the research. According to the frequency distribution of the target population, the number of dairy cattle were divided into three groups. The stratified random sampling method was used in determination of the number of farms that entered the sample from the target population. The size of each sample was found by using Neyman method (Yamane, 1967; Sezgin et al., 2010). This method is as follows;

$$n=\frac{(\sum N_h S_h)^2}{N^2D^2+\sum N_h S_h^2}\ ,D^2=d^2/z^2 \quad (1)$$

where, the sample size (221) is n, total the number of farms in districts (11.968) is N, the number of farms in the h stratum is N_h, the standard deviation for the h stratum is S_h, the variance for h stratum is S_h^2, d is desired absolute precision ($\overline{X} * 0.05$; $\overline{X}$=14.22), z is desired confidence level (1.96 for 95%), D is acceptable error limit in population mean. The sample size was formed by dividing the farms in the two districts to strata based on the number of dairy cattle and then by randomly selecting the farms in these strata. The farms were divided into three groups as 2 to ≤15cattle (92 farms), 16 to <27 cattle (52 farms) and equal 28 and >28 cattle (77 farms). The total sample size was determined as 221 farms.

Descriptive statistics were used to define farmers' communication behaviours, socio-economical and farm characteristics. To determine factors affecting decisions of farmers about the adoption of innovations, the ordered probit model was used. The adoption to define factors influencing an individual's decision about the innovations and an innovation can be described as new idea, product, practice and technical change that is perceived as new by an individual (Rogers, 1995; Boz and Akbay, 2005). Therefore, 23 innovations with regard to dairy cattle activity were determined in order to form the response variable in this model. According to the responses of farmers for these innovations, three adoption groups were created. Thus, farmers who adopted 8 or less innovations were allocated to the low level adoption group, those who adopted between 9 and 17 were allocated to the medium level adoption group, and those who adopted 18 or more were allocated to the high level adoption group. In this context, the dependent variable has three discrete response categories. The dependent variable in this study takes discrete values (McLean-Meyinsse, 1997). Therefore, this model is the most appropriate among the statistical models and they have a natural ordering. Thus, the dependent variable that indicates to adoption levels of innovations of farmers was coded as 0=low, 1= medium, 2=high. STATA software was used for analysis of data (STATA, 2005). The ordered probit model is represented as follows:

$$y^*=\beta' x_i+\varepsilon,\ \varepsilon \sim N[0,1],\ y=0 \text{ if } y^*\le 0,\ y=1 \text{ if } 0<y^*\le\mu_1,\ y=2 \text{ if } \mu_1<y^*\le\mu_2 \quad (2)$$

where y* is un observed, y is observed response variable with three adoption levels, β' is a vector of unknown parameters to be determined, x is vector of independent variables, ε is a vector of random stochastic error terms assumed to be N[0,1] and μ is threshold values (McLean-Meyinsse, 1997).

$$\text{prob}(y=0)=\Phi(-\beta' x),\ \text{prob}(y=1)=\Phi(\mu_1-\beta' x)-\Phi(-\beta' x),\ \text{prob}(y=2)=\Phi(\mu_2-\beta' x)-\Phi(\mu_1-\beta' x) \quad (3)$$

where, Φ is the cumulative standard normal distribution function. The log likelihood function is the sum of the individual respondents' log probabilities and expressed as follows:

$$L=\Sigma_{y=0}\log\Phi(-\beta' x)+\Sigma_{y=1}\log[\Phi(\mu_1-\beta' x)-\Phi(-\beta' x)]+\Sigma_{y=2}\log[1-\Phi(\mu_1-\beta' x)] \quad (4)$$

Marginal effects can be calculated as follows:

$$\frac{\partial P(y_i=j)}{\partial x_k}=[\Phi[\mu_{j-1}-\sum_{k-1}^{k}\beta_k x_k]-\Phi[\mu_j-\sum_{k-1}^{k}\beta_k x_k]\ \beta_k \quad (5)$$

where, $\partial P/\partial x_k$ is the partial derivative of the probability with respect to independent variable x_k. Thus, marginal effects in this model measure the response of farmers' decisions about the adoption of innovations when there is a unit change in the independent variables.

3. Results and Discussion

In Table 1, 23 innovations are presented in order to determine farmers' adoption level of innovations in dairy cattle activity. The most adopted innovation by farmers among these innovations was regular drug use for internal and external parasites (90.5%).

Table 1.Farmers' adoption level of innovations

Innovations	Applied		Not applied		Not aware	
	Number	%	Number	%	Number	%
Regular use of veterinarian services	138	62.4	73	33.0	10	4.5
Growing fodder crops	119	53.8	100	45.2	2	0.9
Animal insurance	71	32.1	144	65.2	6	2.7
Using concentrated feeds	165	74.7	56	25.3	-	-
Milking with machine	62	28.1	158	71.5	1	0.4
Using vitamins for animal feeding	96	43.4	116	52.5	9	4.1
Using minerals for animal feeding	91	41.2	120	54.3	10	4.5
Automatic watering	59	26.7	150	67.9	12	5.4
Automatic feeding	49	22.2	165	74.6	7	3.2
Vaccination against brucellosis	77	34.8	128	60.0	16	7.2
Vaccination against anthrax	82	37.1	121	54.8	18	8.1
Vaccination against charbon	134	60.6	74	33.5	13	5.9
Vaccination against mastitis	72	32.6	149	67.4	-	-
Buying animals with a veterinarian control	89	40.3	121	54.8	11	4.9
Dehorning of calves	62	28.1	137	62.0	22	9.9
Colostrum feeding for newborn calves	163	73.8	50	22.6	8	3.6
Considering crude protein ratio of feed ration	74	33.5	108	48.9	39	17.6
Considering roughage and concentrate feed ration	82	37.1	139	62.9	-	-
Embryo transfer for animal breeding	3	13.4	153	69.2	65	29.4
Regular drug use for internal and external parasites	200	90.5	15	6.8	6	2.7
Private unit for pregnant and sick animals in the barn	151	68.3	64	29.0	6	2.7
Recordkeeping for animal diseases	37	16.7	175	79.2	9	4.1
The existence of foot bath	36	16.3	178	80.5	7	3.2

According to these innovations, it was determined that the adoption level of innovations of 41.6% of farmers were low, 50.7% were medium and 7.7% were high (Table 2). Türkyılmaz et al. (2003) reported that the adoption level of innovations in 19.7% of dairy farms were determined to be high. Boz et al. (2011) found that the adoption level of innovations of 13.1% of farmers were high. Thus, it can be said that the adoption ratio of innovations at a high level of farmers in this study is lower than the findings of previous studies. In this study, the average age of farmers was 48.2 and 45.7% of them were aged between 36 and 51. The average age of farmers was reported to be 44.6, 42.0 and 53.6, respectively in previous studies (McLean-Meyinsse, 1997; Boz et al., 2011; Çukur, 2016). Thus, the average farmers' age in this study is higher than the values explained by McLean-Meyinsse (1997) and Boz et al.(2011), and lower than the value explained by Çukur (2016). The average household size was 3.94 persons in this study. In Turkey, the average household size was 3.4 persons in 2019. McLean-Meyinsse (1997) reported that the average household size was found to be 2.91. Thus, it can be said that the average household size in this study is higher than the findings of previous study and the average household size value at national level. In the present study, the average experience of dairy farmers was 24.1 years. Çukur (2016) found that farmers' dairy farming experience was 28.4 years. Thus, it can be said that the dairy cattle experience of the farmers in this study is lower than the findings of previous study. In this tudy, the majority of the farmers (45.7%) had medium income level (€2819-€5612). Similar results were reported by McLean-Meyinsse (1997), Boz et al. (2011) and Çukur (2016). In this study, 48.4% of farmers had the number of dairy cattle more than 50 head. Hence, it can be said that farmers are in efforts to develop dairy cattle activities. It was found that 52.9% of farmers used internet several times a week. Previous studies showed that farmers almost never use the internet (Boz et al., 2011; Boz, 2014). Thus, it can be said that these results are not congruent with the findings of previous studies, and the ratio of farmers' frequency of the internet use in present study is higher than the ratios that were found in previous studies. Farmers' frequency of meeting with other farmers (30.3%) was found to be at least once a week in the present study. Boz et al. (2011) found that 57% of farmers were reported to meet with other farmers in the village at least once a week. In another study, farmers' frequency of meeting with other farmers was determined as several times a week (Boz, 2014). Thus, it can be said that these results were congruent with the findings from Boz et al., (2011), but not with those from Boz (2014). In this study, farmers' contact frequency with veterinaries (47.5%) was found to be several times a year. Boz (2014) reported that 47% of farmers' contact with private veterinaries were determined as several times a month. Thus, it can be said that the findings of this study are not congruent with the results of previous study, and farmers in the research area have less

contact with veterinarians compared to farmers in Eastern Mediterranean Region. Farmers' contact frequency with agricultural extension personnel (17.6%) were found to be at least once a week in present study. Boz (2014) found that 36% of farmers' contact with extension personnel were determined as at least once a month. Thus, it can be said that the findings of this study are not congruent with the results of previous study and farmers in the research area have more frequent contact with agricultural extension personnel compared to farmers in Eastern Mediterranean Region.

Table 2. Definition of variables used in the ordered probit model (n=221)

Variables	Name of the variables	Frequency	%	Mean	**SD
Dependent variables					
Adoption of innovations	ADOPT				
0=Low level		92	41.6		
1=Medium level		112	50.7		
2=High level		17	7.7		
Independent variables					
Age (year)					
1=≤35 ; 0 otherwise	AGE1	40	18.1	0.18	0.46
1=36-51 ; 0 otherwise	AGE2	101	45.7	0.46	0.50
1=≥51 ; 0 otherwise	AGE3	80	36.2	0.36	0.48
Household size (person)	HSIZE	221	100.0	3.94	1.77
Dairy cattle experience (year)	DAFE	221	100.0	24.1	12.1
*Household income (€ year^{-1})					
1=Low income ; 0 otherwise	INCOME1	34	15.4	0.15	0.36
1=Medium income ; 0 otherwise	INCOME2	101	45.7	0.46	0.49
1=High income ; 0 otherwise	INCOME3	86	38.9	0.39	0.48
Number of dairy cattle (head)					
1=≤20 ; 0 otherwise	NUM1	41	18.6	0.19	0.39
1=21-50 ; 0 otherwise	NUM2	73	33.0	0.33	0.47
1=≥50 ; 0 otherwise	NUM3	107	48.4	0.48	0.50
Frequency of the internet use	INTER				
1=At least several times a week ; 0 otherwise		117	52.9	0.53	0.50
Meeting frequency with other farmers	MEFAR				
1=At least once a week ; 0 otherwise		67	30.3	0.30	0.46
Contact frequency with veterinaries					
1=At least once a week ; 0 otherwise	VET1	54	24.4	0.24	0.43
1=One a month ; 0 otherwise	VET2	62	28.1	0.28	0.45
1=Several times a year ; 0 otherwise	VET3	105	47.5	0.48	0.50
Contact frequency with agricultural extension personnel	EXTEN				
1=At least once a week ; 0 otherwise		39	17.6	0.18	0.38

*1 Euro=6.22 TRY (Turkish lira) in April 2019 (Low income (≤€2818.9), medium income (€2819-€5612),high income (≥€5612), **SD=Standart deviation.

In this study, the McFadden's pseudo R-squared value and likelihood ratio (LR) were calculated to test the goodness of fit of the established model and its explanatory power. The LR and chi-square statistic (chi^2) values were calculated as 62.02 and 22.36, respectively. The null hypothesis at 5% significance was rejected because the LR value was found to be greater than chi^2 value. Thus, all these results revealed that this model is statistically significant and fits for the study. The results of this model and marginal effects of the variables are described in Table 3.AGE2, HSIZE, INCOME2, NUM3, INTER, MEFAR and VET3 were statistically significant at 5% level and DAFE, INCOME3, and EXTEN were statistically significant at 1% level. These results showed that the importance of communication behaviours, socio-economical and farm characteristics on farmers' adoption of innovations. In this study, age had a positive influence on farmers' adoption of innovations, indicating that increase in the age of farmers would bring about higher likelihood of adopting of innovations. Thus, a one-year increase in farmers' age between 36 and 51 years old compared to farmers 35 years and younger would decrease the likelihood of being low level adopters by 17.4%, while it increases the likelihood of being medium level and high level adopters by 13.3% and 4.1%, respectively. Hence, it can be said that middle-aged farmers are more likely to adopt innovations compared to younger farmers. Similar results were reported by Boz et al. (2011) and Boz (2014). However, these results are not congruent with those of Aksoy et al. (2011) and Dhraief et al. (2018), which concluded that there was a

negative correlation between the farmers' age and the adoption of innovations. Thus, it can be said that it is important to make informative meetings about the innovations that can be applied in dairy farming activity to young and middle-aged farmers in the research area and striving towards increase their tendency to adopt innovations.

Table 3. Factors affecting farmers' adoption of innovations

Variables	Coefficient	Standard error	z-statistic	p-value>|z| (probability)	Marginal Effects		
					Adoption levels of innovations		
					Low	Medium	High
AGE2	0.46012	0.22267	2.07	0.039*	-0.174	0.133	0.041
AGE3	0.11011	0.23272	0.47	0.636	-0.042	0.033	0.009
HSIZE	0.10874	0.04817	2.26	0.024*	-0.041	0.033	0.009
DAFE	0.02153	0.00746	2.88	0.004**	-0.001	0.006	0.002
INCOME2	0.63601	0.24929	2.55	0.011*	-0.242	0.189	0.053
INCOME3	0.71786	0.25769	0.79	0.005**	-0.275	0.219	0.055
NUM2	0.43646	0.24897	1.75	0.080	-0.162	0.119	0.042
NUM3	0.55163	0.23448	2.35	0.019*	-0.208	0.160	0.048
INTER	0.42503	0.17735	2.40	0.017*	-0.162	0.127	0.035
MEFAR	0.39689	0.18968	2.09	0.036*	-0.147	0.109	0.039
VET2	-0.08243	0.23936	-0.34	0.731	0.032	-0.025	-0.007
VET3	-0.47425	0.21417	-2.21	0.027*	0.181	-0.141	-0.040
EXTEN	0.75136	0.22656	3.32	0.001**	-0.256	0.159	0.097
/cut 1	0.98369	0.45817					
/cut 2	3.03482	0.49421					
McFadden's pseudo R-squared = 0.15				log likelihood (L_0)= -200.35291			
log likelihood (L_1)= -169.34503				likelihood ratio (LR)= 62.02			
Prob>chi square (chi^2)= 0.000(Probability)				LR>$chi^2(13)_{(0.05)}$= 62.02>22.36			

The levels of significance:*p<0.05; **p<0.01; Variables: AGE2: 36-51 years old; HSIZE: household size; DAFE: dairy cattle experience; INCOME2: medium income; INCOME3: high income; NUM3: ≥50 head; INTER: frequency of the internet use; MEFAR: meeting frequency with other farmers; VET3: contact frequency with veterinaries; EXTEN: contact frequency with agricultural extension personnel.

The size of household had a positive effect on farmers' adoption of innovations, implying that increase in the farmers' household size would bring about higher likelihood of being adoption of innovations. Thus, an increase in the household size of the farmers by one person would decrease the likelihood of being low level adopters by 4.1%, while it increases the likelihood of being medium level and high level adopters by 3.3% and 0.9%, respectively. Similar results were reported by Jerop et al. (2018). However, these results are not congruent with those of Kılıçtek and Aksoy (2019), which concluded that there was a negative correlation between farmers' size of household and the adoption of innovations. Thus, it can be said that farmers seek ways that will increase the income obtain from dairy farming in order to meet the households' food and other requirements when the number of individuals in a household increases. Therefore, it is anticipated that these farmers are more likely to adopt and keep up with these changes by following new technologies or innovations. These findings suggest that large households are more likely to adopt innovation compared to small households. It was found that dairy cattle experience had a positive effect on farmers' adoption of innovations, implying that increase in the farmers' dairy cattle experience would bring about higher likelihood of adopting innovations. Thus, a one-year increase in dairy cattle experience of farmers would decrease the likelihood of being low level adopters by 0.1%, while it increases the likelihood of being medium level and high level adopters by 0.6% and 0.2%, respectively. Thus, years of dairy cattle experience of farmers showed a direct relationship with adoption of innovations, indicating that increase in dairy cattle experience of farmers inclined to increase the likelihood of adopting innovations. Also, this should be ascribed to the fact that farmers with higher experience about dairy farming will have good understanding of production technology and benefits of innovations adoption. Findings on dairy cattle experience of farmers in this research, agreed with the findings of the study conducted in Indonesia (Kariyasa and Dewi, 2011). In contrast with Saliu et al. (2016) and Dhraief et al. (2018) who asserted that there was a negative relationship between the dairy cattle experiences of the farmers and the adoption of innovations. Thus, it can be said that older farmers with long experience are more receptive to adopting innovations and modern technologies compared to young farmers. It was found that household income had a positive influence on farmers' adoption of innovations, implying that increase in the farmers' income would bring

about higher likelihood of adopting innovations. Thus, a one-unit increase in household income of farmers who have medium income compared to low income farmers would decrease the likelihood of being low level adopters by 24.2%, while it increases the likelihood of being medium level and high level adopters by 18.9% and 5.3%, respectively. Also, a one-unit increase in household income of farmers who have high income compared to low income farmers would decrease the likelihood of being low level adopters by 27.5%, while it increases the likelihood of being medium level and high level adopters by 21.9% and 5.5%, respectively. These results are congruent with the findings from the studies of Aksoy et al. (2011), Jerop (2018) and Kılıçtek and Aksoy (2019). However, the findings contradict the results by Asfaw and Neka (2011), which indicated that income had a negative effect on the adoption of innovations. The results showed that the importance of the income increase in farmers' adoption of innovations. Also, it can be said that the low income is an important constraint to reach technology and innovations of farmers. These results revealed that farmer with high income was more likely to adopt than farmer with low income. In this context, supports should be provided towards increasing the income of farmers to encourage innovations adoption. It was found that the number of dairy cattle had a positive impact on farmers' adoption of innovations, implying that increase in the number of dairy cattle would bring about higher likelihood of adopting innovations. Thus, a one-unit increase in the number of dairy cattle of farmers who have over 50 head dairy cattle compared to farmers who have fewer than 20 head dairy cattle would decrease the likelihood of being low level adopters by 20.8%, while it increases the likelihood of being medium level and high level adopters by 16% and 4.8%, respectively. Findings on the number of dairy cattle of farmers agreed with the findings of the studies conducted in Tunisia (Dhraief et al., 2018). Results indicate that livestock owners with a high herd size have a higher tendency to adopt innovations. Farmers go out of their social environment as a result of benefiting from mass communication tools (television, internet etc). This can be accepted as an indicator of farmers' using modern information resources in agricultural activities (Boz, 2014). Frequency of the internet use had a positive effect on farmers' adoption of innovations, implying that increase in the frequency of the internet use of farmers who use internet at least several times a week compared to other farmers would bring about higher likelihood of adopting innovations. Thus, a one-unit increase in frequency of internet use of farmers who use internet at least several times a week would decrease the likelihood of being low level adopters by 16.2%, while it increases the likelihood of being medium level and high level adopters by 12.7% and 3.5%, respectively. These results are in line with the findings of Boz et al. (2011) and Boz (2014). Thus, it can be said that farmer is more likely to learn innovations from this mass media tools depending on their frequency of internet use. Also, it can be concluded that if farmers' internet use increase, they are likely more innovative and tend to be early adopters of innovations. Thus, internet usage training courses should be organized by agricultural extension personnel in order to increase internet use of farmers. Innovations are accepted within a certain time in a society. Changes in this spreading rate depend on the socio-economic characteristics and communication behaviours of individuals who make up a society (Yener and Oğuz, 2017). In this study, it was found that farmers' frequency of meeting with other farmers had a positive effect on farmers' adoption of innovations, implying that increase in meeting frequency of farmers who meeting with other farmers at least once a week compared to other farmers would bring about higher likelihood of adopting innovations. Thus, a one-unit increase in farmers' frequency of meeting with other farmers at least once a week would decrease the likelihood of being low level adopters by 14.7%, while it increases the likelihood of being medium level and high level adopters by 10.9% and 3.9%, respectively. These results were supported by findings of Yener and Oğuz (2017), which showed that there was a positive correlation between farmers' frequency of meeting with other farmers and the adoption of innovations. Thus, it can be said that farmer are more likely to learn innovations depending on farmers' frequency of meeting with other farmers, and other farmers were affected by farmers who adopt innovations. Therefore, farmers who adopt innovations may be given trainings on existing innovations and it may be provided to creating exemplary behaviors of farmers. In this study, it was found that farmers' contact frequency with veterinaries had a negative influence on farmers' adoption of innovations. Thus, a one-unit decrease in contact frequency of farmers who make contact frequency with veterinaries several times a year compared to those who make contact frequency with veterinaries at least once a week would increase the likelihood of being low level adopters by 18.1%, while it decreases the likelihood of being medium level and high level adopters by 14.1% and 4.0%, respectively. Findings on the contact frequency with veterinaries of farmers in this research, disagreed with the results of Boz et al. (2011) and Boz (2014), which indicated that farmers'

contact frequency with private veterinarian had a positive influence on the adoption of innovations. Hence, it can be said that the contact frequency with veterinaries of farmers is quite insufficient. Because, farmers' contact veterinaries depending on their need in animal husbandry. It is important to hold meetings to increase the probabilities farmers' benefit from veterinarians in order to have an impact on the adoption of innovations. In this study, it was found that farmers' contact frequency with agricultural extension personnel had a positive impact on farmers' adoption of innovations, implying that increase in contact frequency of farmers who contact with agricultural extension personnel at least once a week compared to other farmers would bring about higher likelihood of adopting innovations. Thus, a one-unit increase in contact frequency of farmers who contact with agricultural extension personnel at least once a week would decrease the likelihood of being low level adopters by 25.6%, while it increases the likelihood of being medium level and high level adopters by 15.9% and 9.7%, respectively. These findings are consistent with the results of Dhraief et al. (2018) and Jerop et al. (2018). These results are supported by Rogers (1995)' generalizations which show that as farmers have more contacts with extension personnel, they disposed to be early adopters of innovations. Thus, it can be said that if farmers have more communicate with extension personnel, they are likely more innovative farmers, and this characteristic makes it possible for them to benefit from innovations. Therefore, their communication with agricultural extension personnel should be increased in order to provide information about innovations for farmers.

4. Conclusion

The results of this research concluded that middle-aged farmers are more likely to adopt innovations. Hence, it should be provided to make informative meetings about the innovations that can be applied in dairy farming activity to young and middle-aged. In research area, older farmers with long experience are more receptive to adopting innovations and modern technologies. Also, farmer with high income is more likely to adopt than farmer with low income. In this context, support should be provided to increase the farm income of farmers to encourage innovations adoption. Farmer are more likely to learn innovations from this mass media tools depending on their frequency of internet use. Hence, internet usage training courses should be organized in order to increase internet use of farmers by agricultural extension personnel. The contact frequency with veterinaries of farmers is quite insufficient. Hence, it is important to hold meetings to increase the probabilities farmers' benefit from veterinarians.

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