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DETERMINATION OF BEST MANAGEMENT PRACTICES AND INNOVATIONS IN BEEF CATTLE FARMING AND THEIR ADOPTION IN THE EASTERN MEDITERRANEAN REGION OF TURKEY

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Abstract

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The primary purpose of this study was to determine best management practices and innovations in beef cattle farming and their adoption in the Eastern Mediterranean Region of Turkey. A stratified random sample of 170 beef cattle farmers operated in the region was the participant of the study. Data were collected by administering a questionnaire filled during the face-to-face interviews conducted with each individual respondent. Results showed that adoption level was quite low and it was influenced by socioeconomic variables of cooperative membership, investments, farm size, owning improved breeds, and income; and by information-seeking variables of reading newspapers, using the Internet, contacts with extension personnel, and contacts with private veterinarians. It was concluded that governmental support for livestock sector had limited influence on the adoption of BMPs and innovations and therefore on the viability of beef cattle farming. The findings of this study are expected to provide useful information for scientists, policy-makers and extension organizations.

Key words: innovations, best management practices, adoption, livestock, beef cattle farming, ordered probit

Introduction

Beef cattle production in Turkey is not only an important enterprise which makes contribution to a well-balanced diet for consumers, but it is also a type of rural livelihood related to effective use of agricultural and natural resources. Especially in the mixed farms where crops and livestock production take place, input exchange between these two production areas increases economic viability of both sectors, as well as, makes significant contributions to sustainable use of natural resources (Boz et al., 2005). For example, while farm animals are providing manure which increases soil productivity and water holding capacity; they need grassland, pastures, and legume crops for their feeding; and growing these crops, therefore alleviates soil erosion.

Although Turkey in general and the Eastern Mediterranean Region (EMR) more specifically have an enormous potential for livestock and beef cattle production, many different factors are counted among the reasons for not reaching this potential. First of all, it is argued that there have been three major problems with rough and concentrated feeds; (1) feed shortages, (2) low quality, and (3) high prices. Second of all, producers do not posses adequate knowledge and skills for animal production, and there have been a lack of information flow between public and private institutions/organizations and the farmers. Most of the farmers operate in a conventional manner for which the required information is acquired from elders, and neighbor farmers. Research institutes, universities, and extension services cannot establish adequate linkages with farmers to update their knowledge and skills regarding beef cattle production. Lack of farm capital and loan possibilities is counted as the third important factor while lack of improved breeds and inadequate marketing possibilities, the fifth and sixth factors, respectively (Ertugrul and Akman, 2005).

Most of the above problems are related to macroeconomic policies. However, to make remarkable progress in beef cattle farming, a large variety of best management practices (BMP) and innovations must be adopted by farmers. For example, previous research showed that nutrition, pasture manage-

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ment, equality assurance and animal health, marketing and risk management, genetics, and business management were counted as the basic components of stocker production. Each of these management practices has the potential to increase production or to reduce production costs (Johnson et al., 2010). Adoption rates and the reasons for non-adoption of BMPs in beef production were examined from an environmental standpoint (Gillespie et al., 2007), and the BMPs' were investigated in three groups as (1) erosion and sediment control practices, (2) grazing management and (3) mortality, nutrient, and pesticide management. A broader category of BMPs including nutrition and management, forages, quality assurance and animal health, marketing and risk management, business planning and management, and genetics were searched for stocker cattle production (Johnson et al., 2008). Two additional studies concerning with sustainability covered a number of farm level sustainable practices among which are proper care of animal health, personal involvement in commodity marketing, avoiding early and excessive grazing of rangelands, taking protective measures for pastures and meadows, using animal manure for crop production, and pasture grazing rotation (Tatlidil et al., 2009; Boz et al., 2005).

Gaining insight from previous work and conducting preliminary interviews with subject matter experts, identified 23 BMPs and innovations which can be recommended to beef cattle farmers in the locality. Each of these practices is also assumed to increase yield, reduce production costs, and make contributions to sustainable use of agricultural resources as their importance have been emphasized by a large variety of literature. For example, involvement in live animal board makes it possible for farmers to acquire updated information for the prices of live animals. If farmers are aware of animal board, local traders cannot take advantage of them and purchase their live animals with lower prices. This is because commodity boards are the organizations where farm products can be easily exchanged under pure competition conditions using special law and regulations (Kiraz and Gungor, 2003). Animal insurance compensates economic losses due to animal diseases, natural events, and/or accidents. It reduces risks and uncertainties and provides more stable income for farmers (Cetin, 2007; Tanrivermis, 1994; Boz ,1993).

Economically viable fodder is counted as the most important input for beef cattle farming (MARA, 2008; Koknaroglu et al., 2006; Yaylak and Kaya, 2001); as proper determination of concentrated feeds ratio affects productivity and profitability (Koknaroglu et al., 2005). For this reason, using BMPs and innovations such as silage making and feeding; fodder crops growing; using concentrate feeds, vitamins and minerals; fortifying native pasture hay with urea or with molasses-urea mixture; considering roughage to concentrate ratios, protein contents, and metabolic energy content of feeds are very important components for beef cattle farming. In addition, using improved breeds (Akbulut et al., 2004; Sahin et al., 2008), determining the optimum fattening period (Sahin et al., 2009), and using proper vaccines (Uygur, 2007) are among the factors which influence meat production.

Literature on adoption of BMPs and innovations in beef cattle farming shows that there have been many different factors influencing adoption. A recent study conducted with Oklahoma stocker cattle operations (Johnson et al., 2010) found that operation size and dependency upon income from the stocker operation influenced the adoption of recommended practices while older producers and those pursuing a year round production strategy were found to lag in adoption. The study conducted in Thailand found that education, household income, income from beef cattle raising, farm size, number of information source that gave advice about beef cattle raising, and opportunity to get advice were significant variables influenced the adoption of beef cattle raising practices (Suppadit et al., 2006). The study conducted in Louisiana (Gillespie et al., 2007) searched the reasons for producers not adopting best management practices in beef cattle industry and found that two most common reasons for non-adoption were unfamiliarity and non-applicability of the practice. The importance of educational efforts, farm type, and financial structure of the farmers were highlighted in encouraging adoption. Another study conducted in Louisiana (Kim et al., 2005) found that including more enterprises, contacts with Natural Research Conservation Service personnel, education level of farmers, income percentage from beef cattle production, and including hill land influenced the adoption of best management practices in beef cattle production.

Education and income levels of farmers, and their access to credit were found to be effective parameters in adoption of dual-purpose forages as hedgerow species among smallholder farmers in the Philippines uplands (Lapar and Ehui, 2004). Household resource endowment, market integration, and crop integration were significantly effective factors influenced the adoption of improved forage technologies in crop-livestock mixed systems in Ethiopia highlands (Gebremedhin et al., 2003). In the north Queensland beef industry, sufficient level of managerial skills and resources, and experience a declining return per production unit had influence on adoption of innovations which offer a means of arresting that decline (Frank, 1997). Use of computers, veterinary checkup of herd, and herd size influenced the probability of adoption of trichomoniasis vaccine among Nevada range cattle producers (Bhattacharyya et al., 1997).

The present study was the first in Turkey which used a large variety of BMSs and innovations, and employed an

econometric model to investigate farmers' adoption behavior in beef cattle industry.

The primary purpose of the study was to determine BMSs and innovations in beef cattle farming and factors influencing their adoption in the EMR of Turkey. More specifically, the study was intended to address the following objectives:

(1) To determine socioeconomic characteristics and information seeking behavior of beef cattle farmers;

(2) To determine what are the BMSs and innovations in beef cattle farming and their adoption levels among beef cattle farmers in the EMR region;

(3) To determine the extent to which socioeconomic characteristics and information seeking behavior influence the adoption of BMPs and innovations;

(4) To determine the opinions of beef cattle farmers about adoption of BMPs and innovations;

(5) To develop recommendations to be used by extension organizations and other stakeholders when developing extension programs for beef cattle farming and technology adoption.

Results of this study are expected to provide useful information for researchers, policy makers, and personnel of the Ministry of Agriculture and Rural Affairs (MARA).

Materials and Methods

To reach the objectives of the study, face to face interviews were conducted with beef cattle farmers in the EMR of Turkey. During the interviews data were collected by administering a questionnaire including questions related to BMPs and innovations in beef cattle farming, as well as, socioeconomic characteristics and information-seeking behavior of farmers. The data collecting instrument was prepared considering earlier work in the subject, information from public and private institutions, and subject matters experts' opinions. Validity of the instrument was established by a panel of experts, and reliability was tested by conducting a pretest with 20 beef cattle farmers. Modifications were made in the instrument and data were collected during January and June 2008.

To draw an accurate sample first determined 12 districts from the EMR provinces of Adana, Osmaniye, Hatay, and Kahramanmaras. From each district 3 villages were also selected considering the potential of beef cattle farming, socioeconomic conditions of the village, the distance from the district center, and population density of the village. The lists of beef cattle farmers for the 36 villages were obtained and constituted the accessible population of the study. Considering the frequency distribution of the number of beef cattle animals farmers owned, divided the accessible population into three strata: (1) farmers owned less than 50 animals, (2) owned 51-75 animals, and (3) owned more than 75 animals. Using these strata in the stratified sample size determination formula of Yamane (2001), calculated my sample size consisting of 170 beef cattle farmers. I proportionally divided this sample size into three strata and randomly selected the respondents from each stratum. This indicates that every farmer in each stratum had an equal and independent chance of being included in the sample. I predetermined five spare respondents from each stratum- a total of fifteen respondents- and completed the questionnaires with nine of these because the original ones refused to participate in the study. I made it sure to get proper answers for all of the questions I included in the survey. For this reason, I clearly explained the questions when farmers asked so. I requested the village head man or his assistants to provide accompany to establish a trustworthy and friendly atmosphere with farmers. It took approximately 20-30 min to complete a questionnaire.

The following procedures were followed for data analyses: Descriptive statistics including means and standard deviations were used to determine socioeconomic characteristics and information seeking behavior of the respondents (Objective 1). Descriptive statistics including frequencies and percentages were used to determine the adoption levels of BMPs and innovation among the respondents (Objective 2). The ordered probit approach was used to determine the extent to which selected socioeconomic characteristics and information-seeking behavior influenced the adoption of BMPs and innovations among the responses (Objective 3).

In order to construct the dependent variable of the ordered probit model, 23 best management practices and innovations regarding beef cattle farming were determined. Considering the frequency distribution of the responses on the questions whether or not farmers adopted these practices or innovations, three adoption categories were formed. Those who adopted 8 or less practices or innovations were assigned to the low level adoption category, those who adopted between 9 and 16 were assigned to the medium level adoption category, and finally those who adopted more than 20 were assigned to the high level adoption category. The ordered probit model for which the dependent variable of ADOPT had three-discrete response categories was coded as 0 = low level adoption, 1 = medium level adoption and 2 = high level adoption can be expressed as follows:

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

where y^* denotes the vector of unobserved dependent variable, β' denotes a vector of coefficients, x_i denotes a vector of ex-

planatory variables, ε denotes a vector of error terms normally distributed N[0,1], y denotes the observed dependent variable with three adoption levels, and finally μ denotes the threshold values which indicate the inclinations of adoption (Greene 2008). Because the vector of error term is normally distributed, the likelihood of beef cattle farmers falling one of the three categories of the dependent variable can be expressed as:

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

where Φ denotes the cumulative standard normal distribution and μ_1 is greater than zero. Empirically, this model was similarly used by Boz et al. (2011), Boz and Akbay (2005), Chen et al. (2002), Abdel-Aty (2001), and McLean-Meyinsse (1997).

Qualitative data analysis method was used to accomplish objective 4. For this reason, respondents were asked to describe their problems with beef cattle farming and explain the importance of adoption of BMPs and innovations in this enterprise, and the reasons for non-adoption. Their common comments and explanations on this question were noted and reported to accomplish this objective.

Research Findings

The first objective of the study was to identify socioeconomic characteristics and information-seeking behavior of the respondents (Tables 1 and 2). As it can be followed from the Table 1, the mean score of respondents' age was 45.65 (SD = 11.52); 16% were younger than 35, 52% between 35 and 50, and 16% older than 50 years of age. In terms of education, 9% were illiterate, 56% had elementary and 35% beyond elementary school education. Twenty-nine percent had beef cattle farming experience of more than 15 years. Thirty-one percent are in the low income category while 39% in the medium and 30% in the high income category. Twenty-eight percent were member of cooperatives; 15% participated in the village administration; and 35% invested in farm in the last three years. The mean score for the farm size was 61.14 decares (SD = 121.46); 19% had no land, 44% less than 50 decares, 21% between 50 and 150 decares, and 16% more than 150 decares of farm land. The mean scores for the numbers of animals farmers owned were 61.96 (SD = 411.67) for the improved breeds, 15.13 for the native species (SD = 36.72), and 11.2 for hybrid species (SD = 32.09). Fifty-eight percent owned improved breeds while 60% native cows, and 25% hybrid cows. Since some respondents owned more than one category of animals the sum exceeds 100%.

In terms of information seeking-behavior of reading newspaper, 32% read newspapers at least once a week, 27% once a month, and 41% several times a year. Twenty-eight percent of the respondents listened to radio several times a week; 23% several times a month and 48% several times a year. The other information seeking behaviors of the respondents showed the following results: Seventy-five percent watched television every day; 19% used the Internet several times a month and the rest almost never used the Internet; 74% met with other farmers in the village at least once a week; 57% traveled to county center once a week; 25% traveled to province centre at least once a month; 36% had contacts with extension personnel at least once a month; 25% had contacts with private veterinarian several times a month; 12% had contacts with agricultural faculty several times a year; and finally 17% took place in beef cattle extension activities several time a year.

To accomplish the second objective of the study I tried to determine the application levels of the BMPs and innovations among beef cattle farmers. Twenty-three predetermined items were asked to the respondents and their answers were presented in Table 3. From the table the most applied items were regular use of veterinarian services (95.9%), using concentrated feeds (93.5%), animal registration (92.9%), vaccination against feet and mouth diseases (88.2%), and considering roughage to concentrate ratios of feeds (70%). These five items were applied by more than two-third of the respondents. The least applied practices were animal insurance (10%), fortifying native pasture with molasses-urea mixture (8.8%), fortifying native pasture hay with urea (8.2%), and automatic feeding (7.6%). Of the 23 BMPs and innovations 9 were applied by more than 50% of the respondents; hoverer, 14 were applied by less than 50% and 11 were applied by even less than 30% of the respondents. Respondents were not aware of 11 BMPs and innovations and 5 of these were vaccines, with vaccines against charbon and anthrax having the highest percentages as 50%, and 49%, respectively.

The extent to which socioeconomic characteristics and information seeking behavior influenced the adoption of BMPs and innovations among beef cattle farmers was the third objective. To accomplish this objective the ordered probit procedure was used and different models were tried taking the three levels of the dependent variable and the explanatory variables described earlier (Tables 1 and 2). The final models I decided on were included nine socioeconomic characteristics and eight information-seeking behaviors as the explanatory variables (Tables 4 and 5).

The estimated chi-square coefficient (X^2) for the model with socioeconomic characteristics was 108.58 (degrees of freedom = 9), and it was statistically significant at the 0.01 level of probability (Table 4). The threshold coefficient (μ_1 =

1.7913) of the model was also statistically significant at the 0.01 level of probability which indicated that there was a natural order among the three adoption categories of BMPs and innovations.

As it can be followed from Table 4, nine explanatory variables were entered into the model and five were significant at the 0.05 level of probability or lower. All significant variables had the expected signs. The significant variables were cooperative membership (COOP) making farm investments in the last three years (INV), farm size (FS), owning improved breeds (IMP), and income level of farmers (INC). These results verify that as farmers became members of cooperatives, made farming investments in the last three years, had larger units of farms, and owned improved breeds of beef cattle animals their likelihood of being high level adopters of BMPs and innovations increase. However, age of the

Table 1
Socioeconomic Characteristics of Beef Cattle Farmers

Definition of the variables	Name of the variable	Mean	Standard deviation
Age (Continuous variable)	AGE	45.65	11.52
Younger than 35 = 1; 0 otherwise		0.16	0.37
35-50 = 1; Otherwise		0.52	0.50
Older than 50 =1, 0 otherwise		0.32	0.46
Education level	EDU		
Illiterate = 1; 0 otherwise		0.09	0.34
Elementary school =1; 0 otherwise		0.56	0.50
Higher than elementary =1; 0 otherwise		0.35	0.47
Experience (Continuous Variable)		14.95	12.42
More than 15 Years =1; 0 otherwise	EXP	0.29	0.45
Income level*	INC		
Low income = 1; 0 otherwise		0.31	0.45
Medium income = 1; 0 otherwise		0.39	0.49
High income = 1; 0 otherwise		0.30	0.46
Cooperative membership	COOP		
Member = 1; 0 otherwise		0.28	0.45
Participation to village administration	ADMIN		
Participated = 1; 0 otherwise		0.15	0.35
Investments in the last three years	INV		
Invested = 1; 0 otherwise		0.35	0.47
Farm size (Continuous variable)	FS	61.14	121.46
No land = 1; 0 otherwise		0.19	0.39
Less than 50 = 1; 0 otherwise		0.44	0.49
50-150 decares = 1; 0 otherwise		0.21	0.41
More than 150 Decares = 1; 0 otherwise		0.16	0.36
Number of improved breeds (Continuous variable)	IMP	61.96	411.67
Owned improved breeds =1; 0 otherwise		0.58	0.55
Number of native caws (Continuous variable)	NAT	15.13	36.72
Owned native caws =1; 0 otherwise		0.60	0.49
Number of hybrid caws (Continuous variable)	HYB	11.2	32.09
Owned hybrid caws =1; 0 otherwise		0.25	0.43
Adoption of BMSs and innovations	ADOPT		
Low level = 0 (83 farmers or 48.8%)			
Medium level = 1 (62 farmers or 36.5%)			
High level = 2 (25 farmers or 14.7%)		0.81	0.69

respondents (AGE), education level (EDU), farming experience (EXP), and number of native breeds of animals had no influence on adoption.

The marginal effects for significant socioeconomic variables are interpreted as follows: Cooperative membership increased respondents' likelihood of being high and medium level adopters by 11 and 19-percentage points, respectively; however, their likelihood of being low-level adopters decreased by 30-percentage points. The marginal effects for making farming investments showed that those who made investments in the last three years had 5 and 13-percentage point greater likelihood of being high and medium-level adopters, respectively; however, their likelihood of being low-level adopters decreased by 18-percentage point. Larger farm size increased respondents' likelihood of being high and medium-level adopters by 0.01 and 0.03-percentage points, respectively; however, their likelihood of being low-level adopters decreased by 0.04-percentage point. Owning improved breeds increased the likelihood of being high and medium-levels of adopters by 5 and 14-percentage points, and decreased the likelihood of being low-level adopters by 19-percentage points. Finally, the marginal effects for income showed that farmers with higher income had 11 and 31-percentage point higher likelihood of being high and me-

Table 2
Information-Seeking Behavior of Beef Cattle Farmers

Definition of the variables and codes	Name of the variable	Mean	Standard deviation
Reading newspaper			
at least once a week =1; 0 otherwise	NEWS1	0.32	0.46
once a month =1; 0 otherwise	NEWS2	0.27	0.44
several times a year =1; 0 otherwise	NEWS3	0.41	0.49
Listening to radio			
several times a week =1; 0 otherwise	RAD1	0.28	0.45
several times a month =1; 0 otherwise	RAD2	0.23	0.42
several times a year =1; 0 otherwise	RAD3	0.48	0.50
Watching television	TELV		
every day =1; 0 otherwise		0.75	0.43
Using the internet			
several times a month = 1; 0 otherwise	INT1	0.19	0.39
almost newer =1; 0 otherwise	INT2		
Meeting with other farmers in the village			
several times a week =1; 0 otherwise	MOFM	0.74	0.44
Travels to county center			
at least once a week =1; 0 otherwise	CNTY	0.57	0.49
Travels to province center			
at least once a month =1; 0 otherwise	PROV	0.25	0.43
Contacts with extension personnel			
at least once a month =1; 0 otherwise	EXT	0.36	0.48
Contacts with private veterinarians			
several times a month =1; 0 otherwise	VET	0.47	0.50
Contacts with agricultural faculty			
several times a year =1; 0 otherwise	FAC	0.12	0.33
Participation to farming training activities			
several times a year =1; 0 otherwise	TRAINING	0.17	0.37
Adoption of BMSs and innovations			
Low level = 0 (83 farmers or 48.8%)	ADOPT		
Medium level = 1 (62 farmers or 36.5%)			
High level = 2 (25 farmers or 14.7%)		0.81	0.69

dium-level adopters, and 42-percentage point less likelihood of being low-level adopters.

The estimated chi-square coefficient (X^2) for the model with information-seeking behavior was 67.69 (degrees of freedom = 8), and it was statistically significant at the 0.01 level of probability (Table 5). The threshold coefficient (μ = 1.496) of the model was also statistically significant at the 0.01 level of probability, indicating that there was a natural order among the three adoption categories of BMPs and innovations.

Eight explanatory variables were entered into the model and four were statistically significant at the 0.05 level of probability or lower. The significant variables were reading newspapers, use of the Internet, contacts with extension personnel, and contacts with private veterinarians, and all had expected signs. This finding verified that as farmers tended to read newspaper (NEWS1), use the Internet more (INT1); make more contacts with extension personnel (EXT), and private veterinarians (VET) then their likelihood of being high level adopters of BMPs and innovations increased. However, listening to radio, watching television, travels to district centers, and contacts with faculties of agriculture had no significant influence on adoption.

The marginal effects for significant information-seeking variables can be interpreted as follows: The coefficient for NEWS1 suggests that those who read newspapers at least once a week had a 10 and 12-percentage points greater likelihood of being in the high and medium-levels of adoption categories, respectively; however, they had 22-percentage points less likelihood of being in the low-level adoption category. Using the Internet several times a month increased the likelihood of being in the high and medium-level adoption categories by 17 and 13-percentage points, respectively; and decreased the likelihood of being in the low-level adoption category by 30-percentage points. Those who had contacts with extension personnel at least once a month had 7 and 9-percentage point greater likelihood of being high and medium-level adoption categories, and 16-percentage point less likelihood of being in the low-level adoption category. Finally, the marginal effect coefficient for variable VET suggests that those who had contacts with private veterinarians several times a month had 9

Table 3
Adoption Levels of Beef Cattle Farming Best Management Practices and Innovations

Innovations/Best management practices	Applied		Not applied		Not aware	
	N	%	n	%	N	%
1. Regular use of veterinarian services	163	95.9	7	4.1	-	-
2. Using concentrated feeds	159	93.5	11	6.5	-	-
3. Animal registration	158	92.9	12	7.1	-	-
4. Vaccination against foot and mouth disease	150	88.2	6	3.5	14	8.1
5. Considering roughage to concentrate ratios of feeds	119	70.0	51	30.0	-	-
6. Owning improved breeds	99	58.2	71	41.8	-	-
7. Fodder crops growing	94	55.3	76	44.7	-	-
8. Using vitamins for animal feeding	91	53.5	79	46.5	-	-
9. Using minerals for animal feeding	90	52.9	75	44.1	5	4.0
10. Credit use	72	42.4	98	57.6	-	-
11. Silage making and feeding	72	42.4	98	56.7	-	-
12. Involvement in live animal board	52	30.6	99	58.2	19	11.2
13. Vaccination against brucellosis	50	29.4	65	38.2	55	31.8
14. Considering pure protein content of feeds	44	25.9	65	38.2	61	35.9
15. Vaccination against anthrax	36	21.2	50	29.4	84	49.4
16. Vaccination against charbon	35	20.6	50	29.4	85	50.0
17. Considering metabolic energy content of feeds	32	18.8	67	39.4	71	41.8
18. Automatic watering	29	17.1	141	82.9	-	-
19. Vaccination against triangle	21	12.4	73	42.9	76	44.7
20. Animal insurance	17	10.0	153	90.0	-	-
21. Fortifying native pasture with molases-urea mixture	15	8.8	144	84.7	11	6.5
22. Fortifying native pasture hay with urea	14	8.2	137	80.6	19	11.2
23. Automatic feeding	13	7.6	157	92.4	-	-

and 13-pergentage points greater likelihood of being high and medium-level adoption categories; and 22-percentage point less likelihood of being low level adoption category.

Respondents' opinions about the adoption of BMPs and innovations were asked (Objective 4) and three common concerns were identified for the locality: First of all farmers believed that adoption of BMPs and innovations depends on stable income and long term production plans. Because of market fluctuations in beef cattle industry, farmers who highly depend on off-farm inputs are difficult to survive. Those who had no land (19%) had the highest dependency on inputs and therefore less chance of bearing with market risks and uncertainties. This probable makes it impossible for them to adopt BMPs and innovations especially the ones which are costly. A farmer's concern on this issue was translated as the following:

"I know BMPs and innovations increase my profit. But I rented a barn and bought 26 calves in 2-3 years of age for 6 month stocking. Now the prices of concentrate feeds even of roughage feeds are steadily going up. However, I cannot sell my animals in reasonable prices which make profit margins even lower. Thus, in a rental barn and off-farm inputs, how can I follow and adopt BMSs and innovations".

Table 4
Orderd Probit Estimates for the Probability of Innovation Adoption by Socioeconomic characteristics

Variable	Coefficient[1]	Standard error	P	Marginal effects		
				Low level	Medium level	Advanced level
Constant	-3.117***	.6378	.0000			
AGE	.00028	.00941	.9761	-.0001	.0001	.0000
EXPERIENCE	.00057	.00104	.5831	-.0002	.0002	.0001
EDUCATION3	.32736	.23304	.1601	-.1280	.0923	.0357
COOPERATIVE	.82087***	.23948	.0006	-.3051	.1935	.1116
INVESTMENT	.46507**	.21600	.0313	-.1808	.1291	.0517
LAND	.00113*	.00058	.0535	-.0004	.0003	.0001
CULTURED	.48150**	.20998	.0218	-.1888	.1402	.0486
NATIVE	.36718	.22839	.1079	-.1451	.1103	.0348
INCOME	1.0609***	.16883	.0000	-.4199	.3141	.1058
µ1	1.7913***	.20789	.0000			

Log likelihood function = -115.67; Restricted log likelihood = -169.96
Chi squared (9) = 108.58; Prob value = < .01
[1]: Significant at the 0.1(*), 0.05 (**), and 0.01 (***) levels of probability.

Table 5
Ordered Probit Estimates for the Probability of Innovation Adoption by Information-seeking Behavior

Variable	Coefficient	Standard error	P	Marginal effects		
				Low level	Medium level	Advanced level
Constant	-.7092***	.20025	.0004			
NEWSPAPER1	.58348**	.25754	.0235	-.2240	.1196	.1044
RADIO1	-.0673	.22565	.7654	.0267	-.0166	-.0101
TELEVISION	.10109	.22931	.6593	-.0401	.0250	.0151
INTERNET	.84379***	.26533	.0015	-.3094	.1349	.1744
PROVINCE	-.0272	.21233	.8981	.0108	-.0066	-.0042
EXTENSION	.39743*	.23145	.0860	-.1550	.0881	.0669
VET	.57729***	.19656	.0033	-.2244	.1294	.0950
FACULTY	.23529	.28892	.4154	-.0918	.0514	.0405
µ1	1.4965***	.17350	.0000			

Log likelihood function = -136.68; Restricted log likelihood = -169.96
Chi squared (8) = 67.69; Prob value = < .01
[1]: Significant at the 0.1(*), 0.05 (**), and 0.01 (***) levels of probability.

Conclusion and Recommendations

This paper investigated the adoption of BMPs and innovations among beef cattle farmers in the Eastern Mediterranean Region of Turkey giving special attention to socioeconomic characteristics and information-seeking behavior of farmers. In terms of socioeconomic characteristics, a general description for a beef cattle farmer can be made as someone in 46 years of age, elementary school graduate; has 15 years of farming experience, medium level of income, low interest in cooperatives, village administration, and farming investments; owns 61 decares of land, 62 improved breeds, 15 native breeds, and 11 hybrid breeds of animals. In terms of information-seeking behavior he showed low tendency in reading news papers, listening to radio, using the Internet, travels to province center, contacts with extension personnel, contacts with agricultural faculty, and participation to farming training activities; however, he showed high tendency in watching television and meeting with other farmers in the village; and moderate tendency in travels to county center and meeting with private veterinarians. Of 23 BMPs and innovations 9 were applied by more than two-third and 14 were applied by less than one-third of the respondents. There were 9 BMPs and innovations with which respondents were not familiar. Cooperative membership, making farming investments, farm size, owning improved breeds, and income level was significant socioeconomic variables while reading newspapers, using the Internet, contacts with extension personnel, and contacts with private veterinarians were significant information-seeking behavior.

Results of the study verified that adoption of BMPs and innovations among beef cattle farmers in the EMR of Turkey occurred in a low level. Although the selected practices are all useful and their application offers more productive and viable beef cattle farming, only 15% of the respondents had high level adoption, whereas the majority had low level (48.8%) and medium level (37.7%) adoption. I had no possibility to compare these numbers with other developed countries because BMPs and innovations may vary from region to region and no study in the literature used the same methodology. However, from my findings we must accept that adoption level in the research area is very low and this probably lovers economic development due to its adverse effect on investments and economic activities. Literature showed that relatively more innovations and efficiency improvements have been incorporated at the production level of the US cattle and beef industry, and these are considered as critical elements for economic development (Bailey, 2007).

The findings with owning improved breeds (58%) and hybrid breeds (60%) may give positive implications for the future developments; however, unless the BMPs and innovations described in this study; particularly proper feeding, vaccines, and crop insurance are applied, we may not expect long term and stable income from improved and hybrid breeds alone. Therefore farmers need to be supported to apply all the practices which increase production level with improved and hybrid breeds. For this purpose the government initiated a set of support policies to increase the number of improved and hybrid breeds, as well as, to improve their growing and nutrition conditions for higher quality and quantity of production. According to the Livestock Support Decision made by the Council of Ministers (Official Gazette Issue: April 15, 2008; Number 26848) farmers who raise improved breeds and hybrid breeds are paid yearly 350 and 300 Turkish liras per animal, respectively. The same decision also offers direct payments for those who grow fodder crops especially alfalfa, korunga, grass, and annual silage crops. Another decision made by the Council of Ministers (Official Gazette, Issue: April 14, 2009; Number: 27200) provide supports for vaccination. Starting from 2005, governmental support has provided to farmers who insure their agricultural assets against various risks and uncertain situations (Farm Insurance Law, Number: 5363, Date: June 14, 2005). Although similar supports for the livestock sector can be extended from production to marketing, their influences have not yet turned into high level adoption of BMSs and innovations which will lead to a more viable beef cattle industry.

In terms of socioeconomic variables of farm size and income level, this study showed similar results with Johnson et al. (2010), Suppadit et al. (2006) and Kim et al. (2005) studies which indicated that these two variables influenced adoption. (I assumed that the variable "including more enterprises" at Kim et al. (2005) study would have similar influence with "farm size" which was used in my study). Although education level of farmers was positively influenced adoption in the earlier work of Suppadit et al. (2006), Kim et al. (2005), and Lappar and Ehui (2004), it was not significant in our study. In addition, age and experience of farmers had also no influence on adoption. These finding verified that from the socioeconomic factors the ones mostly related to economic rather than social characteristics, such as farm size, income, investments, owning improved species, and becoming member of a farm cooperative influenced adoption. Therefore, livestock policies should focus on economic conditions of beef cattle farmers.

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