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Critical Evaluation for Adoption of Food Safety Systems in the Turkish Dairy and Meat Processing Businesses

F. Cobanoglu[1*], A. D. Karaman[2], and R. Tunalioglu[1]

ABSTRACT

The adoption of food safety systems (FSSs) is of major significance in the food industry, and that approach is especially of more promience in dairy and meat processing firms. In this study the aim was to introduce the factors affecting the probability of adoption of FSSs in the dairy and the meat processing plants in Aydin, western Turkey. It was observed that ten out of twenty-eight dairy businesses had implemented one or more FSSs, and eight out of twenty-six meat processing firms had also implemented one or more of the FSSs. In total, thirty-six enterprises had not adopted any food safety system intended for safe food production, eighteen of which were involved in dairy and eighteen in meat processings. Binomial logistic regression model was employed throughout the study. The results indicated that plant characteristics and activities play a major role in determining the relative importance of various incentives in adopting food safety practices. The results also indicated that the larger business plants benefitted from a greater marginal probability of being adopters of FSSs as compared with the other business properties. The businesses that had employed ten to fourteen, fifteen to twenty, or more than twenty employees along with a food engineer and/or a veterinarian as a permanent employee were more likely to adopt FSSs than firms that were employers of fewer staff. Moreover the study indicated that care of hand disinfection had a positive and statistically significant relationship with the decision of any firm to adopt FSSs. On the other hand, the positive and significant impacts of such other factors as knowledge of risk resources, presence of wastes, sufficient air ventilation, and also firm specialties like fewer ordinary employees, as well as the type of business sector (dairy or meat firms) did not prove possible to be verified.

Keywords: Adoption, Binary logistic model, Dairy and meat processing firms, Food safety.

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INTRODUCTION

The adoption of food safety and quality practices differs among varying enterprises. This variation reveals incentives as understood by each business to supply safe food products. These incentives may be externally driven (e.g., to meet legal requirements or to meet the needs of major customers) or internally driven (e.g., to improve operational efficiency or to reduce error rates, wastage, and costs). Other incentives may include the enhancement of reputation or brand name capital (Klein and Leffler, 1981), the prevention or diminution of liability damages (Antle, 2001), or as well the reduction in transaction costs among partners in the supply chain (Caswell *et al*., 1998; Holleram *et al*., 1999).

Many studies have investigated the factors affecting adoption of food safety systems (FSSs) in different countries e.g. Canada, (Jayasinghe-Mudalige and Henson, 2007), Italy (Romano *et al*., 2004), Australia (Khatri and Collins, 2007) and United Kingdom (UK) (Mensah and Julien, 2011) in such different sectors as catering, meat and poultry processing. While the tendency

[1] Department of Agricultural Economics, Agriculture Faculty, Adnan Menderes University, Aydin, Turkey.
*Corresponding author; e-mail: ferit.cobanoglu@adu.edu.tr
[2] Department of Dairy Technology, Agriculture Faculty, Adnan Menderes University, Aydin, Turkey.

to adopt practices for safer food products depends mainly on the above mentioned incentives, a firm's characteristics and activities play a major role in determining the relative importance of such incentives. Acknowledging the importance of firm peculiarities, Henson and Holt (2000) noted that it was not possible to generalize the impacts of a particular set of incentives on the level and the type of food safety controls that are adopted by firms. This, in turn, was because firms had their own different characteristics, objectives, types of products produced or manufactured, and the operating environments. Seddon *et al*. (1993) surveyed about 650 ISO 9000 adopters in the United Kingdom and reported that fifty-one percent of large firms *vs.* thirty percent of small ones anticipated reducing their costs as a result. On the other hand, forty-eight percent of the large firms *vs.* seventy-one of the small ones expected to increase their market share as a result of ISO 9000 certification. McDonald and Cruthfield (1996) discussed the importance of considering such plant heterogeneities as firm size, and product mix in determining the incentives of a firm to adopt food safety assurance systems. Hobbs *et al*. (2002) argued that the essential factors driving change in the approach to food safety in Canada have been the external ones. Shavell (1987) suggested that in general, a firm's incentives to supply safe products might be affected by its size, its organization, and as well the structure of its market.

In light of this previous research, one could expect a systematic association between the peculiarities of firms and the incentives in adopting specific food safety and quality practices. Jin *et al*. (2008) presented the results related to the adoption of an HACCP (Hazard Analysis Critical Control Points) system in the Chinese food industry as based on a survey of 117 food enterprises in Zhejiang Province, China. They stressed the benefits *vs.* the barriers to implementation of FSSs within the framework of a multidimensional concept. Maldonado-Siman *et al*. (2009) asserted that the four principal factors that motivated enterprises to adopt an HACCP system were associated with improvement of plant efficiency and profitability, adoption of good practices, improvement of product quality, as well as waste reduction. Arpanutud *et al*. (2009) emphasized the results of hypothesis testing and indicated that the adoption of a food safety management system could be significantly predicted by: expected gain of social legitimacy, expected gain of economic competitiveness, perceived importance of external stakeholders (government, community, food safety organizations, and media), top management commitment to food safety, firm size, and the level of export sales. Finally, key drivers affecting the adoption probability of FSSs are legislative requirements, insurance necessities (Loader and Hobbs, 1999), customer requirements, employee necessities (Henson and Hooker, 2001), prospects of enhanced corporate image (Romano *et al*., 2004), procedural and operational efficiency, as well as acceptable practices (Khatri and Collins, 2007; Jayasinghe-Mudalige and Henson, 2007).

Therefore, the procedures of implementation for FSSs have multidimensional windows with respect to these enforcements. Thus, in explaining the propensity of firms to adopt food safety and quality practices, one must consider such factors as industry type, size, market structure, and the major markets served by the firms (Hassan *et al*., 2006).

Although the papers indicated above would give proper and detailed information in various food sectors, relatively few investigations have been carried out to investigate factors related to the adoption of FSSs in dairy and meat processing firms. On the other hand, the main purpose followed in this study was to determine the major characteristics and incentives that influence adoption decisions of FSSs in Turkish dairy and meat enterprises. The conceptual framework and the related data are presented in the following section. The results of binomial logit model are synthesized in the third part. Finally, the critical implications are deduced in the conclusions.

MATERIALS AND METHODS

Conceptual Framework

Karshenas and Stoneman (1993) hypothesized that expected profit gain by adoption of a new technology by a firm in a specific industry will depend on the peculiarities of the firm (rank effect), the number of other adopters (stock effect), and the firm's position in the order of adoption among the competitors (order effect). While the stock and order effects are important in determining the dynamic dissemination of technology adoption, rank effect would determine cross-sectional difference in new technology adoption behavior among firms (Madlener and Wickart, 2004). In general, these three effects would define a firm's gross returns from the use of new technology (Herath *et al*., 2007).

Assume a specific firm's expected gross profits by adopting a new technology are G_i, while the expected gross profits without adopting the new technology G_0. In a static framework, the firm would adopt the technology when the difference (D_i) between the expected gross profits by adoption and nonadoption ($D_i = G_i - G_0$) exceeds some reservation obtaining cost (α_i) of adopting the new technology (Hall, 2006).

The firm characteristics (rank effects), through a set of firm-level incentives, would determine the level of D_i. Indeed, the influences of firm characteristics on D_i are likely to be multidimensional and interactive where a given firm characteristic may be associated with many incentives related to D_i. Thus, quantification and developing testable inferences of the direct impact of individual firm characteristics on a given incentive related to D_i is a formidable draft, which has not been undertaken here. Instead, the emphasis is that, while the individual impacts of each firm characteristic on a specific incentive, hence on D_i, is discussable, a list of firm characteristics jointly defines the net profit gain (D_i) through adopting an enhanced food safety system. Further, it is debated that the exterior indication of this net gain (D_i) is the adoption (when $D_i > \alpha_i$) or nonadoption (when $D_i \leq \alpha_i$) decision of the firm and that this decision is affected, in turn, by a range of firm characteristics. Therefore, it is possible to empirically test the association between firm characteristics and adoption decisions. The value of D_i for a specific firm depends upon the kind of firm characteristics related to that firm and a random error term ε_i. The regression coefficient for the kth firm characteristic is denoted as β_k, and the term $\sum_{k=1}^{K} = \beta_k X_{ik}$ is appropriately denoted as Z in Equation (1) below (Herath *et al*., 2007):

$$D_i = \sum_{k=1}^{K} \beta_k X_{ik} + \varepsilon_i = Z_i + \varepsilon_i \qquad (1)$$

We are not in a possession of a direct quantification of each firm's D_i or α_i in pertinence to adopting the new technologies for enhancing food safety systems. The classification of firms into "adopters" and "nonadopters" is indirectly based on the values of D_i in conjunction with a reservation acquisition cost α_i. The dichotomous outcome of the adoption decision is evaluated by the dependent variable (Y). If $D_i > \alpha_i$ the firm is defined as an "adopter" and $Y_i = 1$. On the other hand, if $D_i \leq \alpha_i$, the firm is defined as a "nonadopter" and $Y_i = 0$.

Therefore, the probability of a given firm preferring to adopt can be characterized by employing the relationship in Equation (1):

$$\Pr(Y_i = 0) = \Pr\left(\sum_{k=1}^{K} \beta_k X_{ik} + \varepsilon_i \leq a_i\right) \qquad (2)$$

$$\Pr(Y_i = 1) = \Pr\left(\sum_{k=1}^{K} \beta_k X_{ik} + \varepsilon_i > a_i\right) \qquad (3)$$

Since Equations (2) and (3) take up all probabilities of the random variable ε, such probabilities can be characterized by a cumulative probability density function

(Davidson and MacKinnon, 1993; Herath *et al*., 2007). The logistic distribution has been elected to characterize ε, where Pr ($\varepsilon \leq$ x) would be $\frac{1}{1+e^{-x}}$. Thus, the probabilities of Y_i= 1 or 0 would be:

$$\Pr(Y_i = 0) = \Pr(\varepsilon_i \leq a - Z_i) = \frac{1}{1+e^{(Z_i - a)}} \quad (4)$$

$$\Pr(Y_i = 1) = \Pr(\varepsilon_i > a - Z_i) = 1 - \frac{1}{1+e^{(Z_i - a)}} \quad (5)$$

Employing the maximum likelihood method, one can specify the value of β_k that maximizes the joint probability of observing a given sample. Thus, once the parameters of the model are specified, it is possible to calculate Pr(Y_i= 0) and Pr(Y_i= 1) for an individual firm and the alterations in these probabilities according to different firm characteristics (Herath *et al*., 2007).

The binomial logit model (logistic regression) seems suitable for a determination of the affecting factors in adoption of FSSs in the dairy and meat processing firms. The adoption of FSSs in the dairy and meat enterprises is a binary variable indicating whether a manager is the adopter of the food safety system or not. The determinants could thus be forecasted by employing the linear probability model, probit model, or logit model. Singh (2003) used the linear probability model but it had many such inherent constraints as non-normality of distribution, heteroscedasticity, and more. Also, the assumption of a linear relationship between the value of an independent variable and the probability of a dependent variable is not realistic (Gujarati, 1999). The probit and logit models thus provide better alternatives for such an estimation. The major difference between the two models is the flatness of the tails of their Cumulative Distribution Functions (CDFs). The logit model has slightly flatter tails (Greene, 2002), which means the probit curve approaches the axes more quickly than the logit curve. Gujarati (1999) stressed that the choice between the two methods is largely one of convenience of estimation and availability of suitable computer programs. The logit model is fairly simpler for estimation than the probit model. Thus, the logit model was employed to estimate the effect of the factors on adoption decision of FSSs in the dairy and meat firms.

Data Collection

Throughout the present study there was used a structured questionnaire developed while considering the previous studies and observations. The survey questions were constituted based on a list of factors motivating HACCP, ISO 22000 or other system implementations, costs, benefits, as well as barriers against adoption. The firms' characteristics as well as the managers' opinions and knowledge levels on risk sources and on the presence of wastes; the roles of hand prompt and necessary disinfection, and as well air ventilation were employed as main incentives in the overall processing period in the firms. The draft questionnaires were subsequently revised by the researchers on the basis of feedback from participants in the in-depth interviews. The related interviews were carried out using the whole count method with all the managers of fifty-four dairy and meat processing businesses in the region, twenty-eight of which were involved in dairy processing and twenty-six in meat processing in Aydin, western Turkey. The visits to the firms were conducted from April to August 2010, while the data being collected *via* surveys. Ten dairy firms and eight meat firms had implemented one or more FSSs. In total, while eighteen businesses had adopted at least one food safety system, thirty-six enterprises had adopted no system intended for safe food production.

Several incentives were hypothesized to affect the adoption decision.

(1) Such firm characteristics as establishment size, subsector, product mix,

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food engineer and/or veterinarian employment.

The reference group for the variable establishment size was defined as five employees because most of the firms' managers employed at least five. The reference group for the variable product mix was set at one since the firms often process only one product. This product often consisted of cheese in the dairy processing firms while sausage in the meat processing ones.

(2) Concerns in the overall processing period such as knowledge of risk sources, presence of wastes, taking a close care of hand disinfection, and a consideration the role of air ventilation.

The independent variables were selected as based upon two reasonings. First, some specific factors indicated in previous papers were taken into consideration. Thus, the outlines in this study and the findings of previous researchers will be compared with each other as related to the adoption of practices of food safety. Second, although relatively few have studies investigated the critical parameters on adoption of decisions in many food sectors, their conclusions may not be completely applicable to such a developing country as Turkey. So, it was decided that the selected variables would be appropriate in Turkish dairy and meat processing enterprises with regard to these issues. One of the major studies carried out by Demirbaş *et al.* (2008) stressed that lighting, air conditioning and hygienic conditions are of very important concern in Turkish milk collection centers intended for adoption of food safety practices and they assessed the adequacy of these prerequisites within the other large perspectives in Turkey. The dependent and independent variables developed while utilizing this information for the final empirical analysis are listed in Table 1.

RESULTS AND DISCUSSION

The empirical results provide information

Table 1. Variables related firm characteristics and incentives for food safety systems' adoption.

Dependent variable	Description	Mean	Std. deviation
HACCP, ISO 22000 and/or another food safety system	*Y*= 1 (if yes) *Y*= 0, otherwise	0.330	0.476
Independent variables	Description	Mean	Std. deviation
Firm characteristics			
Establishment size	5-9 Employees= 1, Otherwise = 0	0.200	0.407
	10-14 Employees= 1, Otherwise= 0	0.090	0.293
	15-20 Employees= 1, Otherwise= 0	0.090	0.293
	>21 Employees= 1, Otherwise= 0	0.06	0.231
Subsector	Dairy= 1, Otherwise= 0	0.519	0.504
Product mix	1-3 Products= 1 Otherwise= 0	0.280	0.452
	>3 Products= 1 Otherwise= 0	0.540	0.503
Food engineer and/or veterinary employment	If Yes= 1, Otherwise= 0	0.560	0.502
Concerns in the overall processing period			
Knowledge of risk sources	If Yes= 1, Otherwise= 0	0.500	0.505
Presence of wastes	If Yes= 1, Otherwise= 0	0.463	0.503
	If Yes= 1, Otherwise= 0	0.352	0.482
Taking close care of hand disinfection			
Taking care of proper ventilation	If Yes= 1, Otherwise= 0	0.500	0.505

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in answering the following question: What is the relationship between adoption of FSSs and characteristics of the dairy and the meat processing businesses (e.g., establishment size, subsector, food engineer and/or veterinarian employment) and perceptions of the firm managers (e.g., knowledge of risk sources, presence of wastes, taking close care of hand disinfection, taking care of ventilation)?

To address this question, data from the survey study performed in the dairy and meat processing firms are utilized to estimate the probability of the adoption of food safety practices versus nonadoption. The estimated coefficients for the binomial logistic regression model are presented in Table 2. Note that the estimated coefficients in the binomial logistic model provide the qualitative effects of the independent variables and show the direction change. According to an in-depth literature review, characteristics of the food firms and lots of such incentives as awareness of the hygiene practices, waste management, and the like could take strategic roles in the adoption of FSSs depending on food industries' and countries' trade habits such as export orientation and so on. This argument can be more valid in dairy and meat firms than in other food enterprises. The probability estimates reported the quantitative as well as marginal effects of changes in independent variables.

The quantitative effect of a dummy variable is evaluated through a comparison

Table 2. Binomial logistic regression for the firm characteristics and practices intended for food safety adoption.

Variable	Coefficient [a]	Marginal probability percentage point
Constant	-5.1883 (1.9977)***	
Establishment size:		
5-9 employees	1.0187 (1.1852)	22
10-14 employees	4.1131 (1.6488)**	74
15-20 employees	3.1709 (1.6000)**	65
> 20 employees	4.4647 (2.0050)**	74
Subsector	0.3140 (1.0881)	6
Product mix:		
1-3 products	1.2403 (1.2398)	26
> 3 products	0.5149 (1.0298)	10
Food engineer and/or veterinary employment	1.9609 (1.1646)*	35
Concerns in the overall processing period:		
Knowledge of risk sources	0.1449 (0.8991)	3
Presence of wastes	-0.3420 (0.8889)	-7
Taking care of hand disinfection	1.7697 (0.9145)*	37
Taking care of ventilation	1.1768 (0.8783)	23
Number of observations	54	
Wald χ^2 (12)	24.0203	
McFadden R^2	0.3536	
Goodness-of-fit statistics		
-2 Log likelihood	43.903	
Cox and Snell R Square	0.364	
Nagelkerke R Square	0.504	
Hosmer and Lemeshow Test (Chi-square)	11.919	
Percent concordant	81.1	
Percent discordant	18.6	

[a] The numbers in the parenthesis denote standard error of means.
*, **, and *** represent statistical significance at 0.1, 0.05, 0.01 level, respectively.

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of the probabilities when the dummy variable takes on one specific value *vs.* the probabilities when the dummy variable assumes another specific value. The marginal probability is the difference between the mean probability values of the second and first comparison (Borooah, 2002). The values of all other variables in the model are held fixed during the comparisons (Hassan *et al*., 2006).

McFadden (1973) suggested an alternative, known as the "likelihood-ratio index," comparing a model without any predictor to a model including all predictors. It is defined as one minus the ratio of the log likelihood with intercepts only, and the log likelihood with all predictors. If the slope parameters are all zero, McFadden's R^2 is zero, but it is never one. McFadden's R^2 values of 0.2 and 0.4 are considered as highly satisfactory (Tektaş and Günay, 2008). In the present model that was presently examined, McFadden's R^2 values were close to 0.4, indicating the model to be highly satisfactory. Other such goodness of fit statistics as the Likelihood ratio Test, *-2 Log* likelihood, Cox and Snell R Square, Nagelkerke *R* Square, Hosmer and Lemeshow Test indicated that the model was fit (Table 2). For this reason, the binomial logit model was considered as appropriate. In general, the estimates reported in Table 2 for binomial logistic regression appear to be logical. All the estimated coefficients exhibited plausible signs.

Table 2 indicates that businesses that employed ten to fourteen, fifteen to twenty, as well as more than twenty employees with a food engineer and/or veterinary employee and as well took close care of hand disinfection were more likely to adopt FSSs. The probability of adopting one and/or more FSSs increased from the smallest size to the largest ones. Also, large enterprises of more than twenty employees with a food engineer and/or veterinary employee and as well taking close care of hand disinfection practices in the processing period provided incentives for adoption decisions. Plant characteristics/activities and awareness of disinfection practices took a major role in determining the relative importance of various incentives and adoption of FSSs.

Marginal probabilities, reported in Table 2, confirmed the aforementioned results. Following a control of all other variables, the results indicated that firms in larger the size class carried the greatest marginal probability of being adopters of food safety practices as compared to businesses of other characteristics. As size class increased from smallest to the largest, the probability of being an adopter increased by twenty-two, seventy-four, sixty-five, and seventy-four percentage points, respectively (Table 2). That is, there was a seventy-four percentage point difference in the probability of being an adopter (one or more FSSs) when the largest and the smallest businesses compared. Employment of a food engineer and/or veterinary employee had a higher probability of adoption (a thirty-five percent difference) relative to the businesses with no such an employment. And finally, the firms' scrutinized attention to hand disinfection resulted in a higher probability (thirty-seven percentage point difference) of adopting food safety practices in comparison to the other firms.

Several specific inferences can be drawn from the results of the study. First, firm size had a positive effect on the adoption of such FSSs as HACCP, ISO 22000, and others. This outline is also coherent with many implications reported by Gormley (1995), Mortlock *et al*. (1999), and Seddon *et al*. (1993). In other words, the results from the current analysis confirms the findings of existing research in that the probability of adoption of particular food safety and/or quality assurance practices increased from the smallest to the largest establishments. If a wider adoption of food safety controls could be achieved, especially among smaller and medium-sized establishments, this would provide greater social benefits within the framework of the firm-level private costs, regulations, and their enforcements. Thus, such financial and technical supports

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as training should be provided to the smaller and to medium-sized firms.

The results also suggested that being in the larger establishment (ten employees or more) classes influenced the adoption of a combination of food safety practices more than most other firm characteristics and concerns. While the economies-of-scale argument might be an appropriate explanation for this adoption pattern, synergies associated with enhanced food safety and quality controls for large firms in maintaining customer satisfaction might be the essential driver in this aspect. That point has also been argued by Herath *et al*. (2007). Antle (1995), Holleram *et al*. (1999), and Taylor (2001) examined the negative aspects incentives of higher per-unit production costs of adopting food safety and quality practices for smaller firms. Antle (1995) noted that because the monitoring and the recordkeeping requirements of regulations were largely fixed costs, the average cost per unit of production was higher for smaller firms than for larger ones. Financial constraints were a practical barrier to implementing HACCP, felt by governments and industry alike, and could be particularly acute in small and medium-sized enterprises (Anonymous, 2006). The problem for smaller establishments was the high fixed costs associated with the implementation and maintenance of food safety assurance systems.

This phenomenon may be more critical in such developing countries, as Turkey. In the present study, the dairy and meat processing companies suffered from the same financial difficulties. Although the businesses have been working under low inflation rates for the last five to six years, the managers of the firms have continued their activities as if they were still in a high-inflation environment. That phenomenon might have compelled the firms to work more carefully and cautiously in the input acquisition and marketing stages in particular. Thus, the dairy and the meat businesses seem to have preferred working in more moderate conditions in domestic markets instead of taking large risks and uncertainties. It is likely that the economic crisis that broke out worldwide in 2008 has been accelerating the firms' changes in behavior to act with more forethought. The additional costs required for the adoption of FSSs in these firms may be one of the most important limitations in the food supply chain. The current global-scale economic crisis and high inflation expectations in Turkey can be considered the major bottlenecks to the implementation of FSSs at the desired level.

One of the most interesting results obtained in the study is that increasing the awareness of firm managers about taking care of hand disinfection could create a precise rise in the adoption probabilities of FSSs in the firms investigated. Angelillo *et al*. (2001), Baş *et al*. (2006), Gomes-Neves *et al*. (2007), Jevsnik *et al*. (2008) and Tokuç *et al*. (2008) discovered that the attitudes of food workers were very positive toward food safety measures while they suffered from relatively poor practices. Ansari-Lari *et al*. (2010) also reported a significant negative association between both factors of the level of knowledge and attitudes *vs*. practices devoted to food safety approach. The present study proved that there was an affirmative connection between a positive tendency of the firm managers towards FSSs and adoption of those systems in the dairy and meat enterprises.

Incentives to meet consumer demand and to address food-safety-related issues are firm-specific. The type of industry/firm (e.g., meat, dairy, or cereal) will generally determine the level of consumer pressure for adopting food safety and quality practices (Hassan e*t al*., 2006). This pressure will likely be greater for firms involved in meat and dairy while relatively smaller for firms in cereal or bakery. The type of industry or firm could help explain the importance of meeting consumer demands as an incentive to adopt food safety and quality practices (Herath *et al.,* 2007). However, during the ongoing study it was found that the variable subsector (meat and dairy) was not an effective factor on adoption decisions.

The awareness of risk resources, presence of wastes, and a consideration of the roles of air ventilation were not found to have significant effects on FSSs adoption. This finding is harmonious with the findings of Jin and Zhou (2011). They also stressed that in such a developing country as China, agricultural cooperatives may not yet be fully aware of the effectiveness of food quality and safety standards, and this poses a barrier against their adoption decisions. The authors believe that these points may also indirectly result from the regulatory framework on food safety issues implemented in Turkey.

The many papers focused on this topic could give critical clues. For example, regulatory requirements and the potential for liability damage also depend on firm-specific characteristics. Firms more prone to specific hazards, such as pathogens in seafood, meat, and milk, or chemical and pesticide residues in vegetables and fruits, will likely have liability-related incentives (Herath *et al*., 2007). Henson and Holt (2000) reported that meeting legal requirements was the most important incentive among the ISO 9000 adopters in the dairy industry in the United Kingdom. Similarly, the major market served by a given firm also affected the incentives related to meeting legal requirements. For example, Canadian firms exporting meat to the United States must have an HACCP system in place.

The industry type and the major market served are two possible characteristics that could explain the importance of legal requirements as an incentive to adopt food safety and quality practices; however, the legal regulations that have been implemented so far in Turkey have demonstrated complex characteristics. Although that complexity may be creating problems in maintaining a centralized structure for monitoring and intervention, the nation has recently begun to enforce more specific guidelines to ensure the effectiveness of food safety control as well as monitoring in many instances. The recent enforcement of Law No. 5996 requiring the services of veterinary, plant health, food and feed laws published on 13.6.2010, as required by the EU accession period (Anonymous, 2010) and previous regulations have forced the HACCP rules to be enforced as obligatory in Turkey. Although many good practices and incentives considered risk sources, the role of air ventilation, and others have been implemented, many poor and insufficient practices could still be observed in quite a few food firms. Thus, since most of the firms would be trying to employ these good practices, these incentives could not have a statistically significant effect on adoption decisions for FSSs in the dairy and meat enterprises.

CONCLUSIONS

This study provided a unique and in-depth analysis on the adoption of FSSs in Turkish dairy and meat processing firms. Ten of twenty-eight dairy businesses implemented one or more FSSs, and eight of twenty-six meat processing firms also adopted one or more FSSs. In total, while eighteen businesses adopted at least one food safety system, thirty-six enterprises would not adopt any system intended for safely in food production. According to the binomial logistic regression analysis, the probability of being an adopter increased from the smallest firms to the largest ones. Also, the employment of a food engineer and/or veterinary employee (veterinarian) and awareness of disinfection and hygienic production provided incentives for the desired adoption decision. The firms that put emphasis on hand disinfection and hygienic processing benefitted from a more probability of adopting food safety practices than the other firms. The effects of the other variables influencing the adoption of decisions were not proved in this study.

The above results indicate that plant characteristics and activities played a major role in determining the relative importance

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of various incentives and in turn the intensity of adopting food safety practices. Following a control of all other variables, the results showed that firms in the largest size class benefitted from the greatest marginal probability of being adopters of food safety practices as compared with other business characteristics. The outlines from the current analysis suggested that the probability of adoption of FSSs increased from the smallest to the largest establishments. The results also suggested that being in the larger establishment size classes (ten employees or more) further influenced the adoption of FSSs relative to most other firm characteristics and activities. A wider adoption of food safety controls, especially among smaller and medium-sized establishments, would provide greater social benefits within the framework of the firm-level private costs, regulations, as well as enforcement. Thus, such financial and technical supports as credit-easing, trainings, and more should be adequately channeled to the smaller and medium-sized firms.

The additional costs needed for the adoption of FSSs in the firms may be one of the greatest constraints in the food supply chain. This implication may show that the managers of the firms could prefer working in more moderate and reliable environments in well-known domestic markets instead of taking large risks and uncertainties. It is likely that the economic crisis that broke out worldwide in 2008 has been accelerating the changes of the firm managers' perceptions to take less risks as soon as they are able to.

One of the most interesting results discovered from the research was that awareness of the firm managers in relation to taking care of hand disinfection acts as one of the major incentives in the adoption of FSSs in Turkish dairy and meat firms, as compared with the perceptions concerning risk resources, presence of wastes, as well considering the role of air ventilation were not found to have significant effects on FSSs adoption. This indicated the managers of the firms perceived that taking care of hand disinfection is a high priority as compared with the other such variables employed in the model as the information intended for risk sources, wastes, and air ventilation. The study may assert that a comprehension of the managers of food safety approaches can be linked with their taking pains to promote hand disinfection more than other parameters investigated. Based on these outlines, it is recommended that training activities for firm managers should be accelerated to establish implementation of other food safety practices that may not be at present evaluated as important as taking care of hand disinfection in a developing country like Turkey.

On the other hand, the industry subsector variable (meat and dairy) was not a conspicuous affecting factor on the adoption decisions. The latter result may arise because the incentives to adopt FSSs are similar in both industries although sector-specific firm characteristics and practices as well as the environment in which firms operate would probably define the relative importance of different incentives to adopt food safety and quality practices (Caswell *et al*., 1998; Hassan *et al.,* 2006). It was determined in this research that there are no precise differences in the perceptions of managers of dairy *vs.* meat processing firms in terms of adoption of FSSs which may be thought as exceedingly important for human health in comparison to other sectors in Turkey.

In the light of this research discovery, more resources and information should be allocated to the managers of the food firms to obtain more awareness on food safety and adoption process of FSSs in such developing countries as Turkey. In understanding the firms' adoption behavior, public agencies and media would be able to more efficiently channel the limited available sources, thus achieving the objectives of enhanced food safety and quality, as well as an increased consumer confidence in the country's food systems (Huff and Owen, 1999; Woteki, 2000).

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برآوردی از سیستم های ایمنی غذائی در مشاغل صنایع لبنیات و فرآوری گوشت در ترکیه

ف. کوبان اغلو، ا. د. کارامان، و ر. تانالی اغلو

چکیده

بکارگیری "سیستم های ایمنی غذائی" از اهمیت خاصی در صنعت محصولات غذایی برخوردار است و این امر خصوصاً در کارخانجات محصولات لبنی و مراکز فرآوری گوشت حائز اهمیت بیشتری است. هدف از این تحقیق خاضر عبارت است از معرفی عواملی که بر احتمال پذیرش" سیستم های ایمنی غذایی" در کارخانجات محصولات لبنی و مراکز فرآوری گوشت در محل آیدین (غرب ترکیه) تاثیر گذارند. چنین مشاهده گردید که تعداد ده واحد از ۲۸ واحد فرآوری محصولات لبنی، فقط یک یا بیش از یک مورد از موارد، سیستم های ایمنی غذایی را ب کار بسته بودند. در عین حال در مورد مراکز فرآوری گوشت از هر ۲۶ واحد تعداد هشت واحد و در هر یک از این واحدها یک یا بیش از یک مورد از سیستم های ایمنی غذایی ب کار گرفته شده بود و در کل تعداد ۳۶ واحد (۱۸ واحد مربوط به محصولات لبنی و ۱۸ واحد در رابطه با محصولات گوشتی) هیچ یک از انواع سیستم های ایمنی را بکار نگرفته بودند. در این تحقیق از رگرسیون دو جمله ای لوجستیک استفاده شد. نتایج حاصله بر این نکته اشاره داشتند که خصوصیات و فعالیت های کارخانجات و مراکز نقش مهمی را در رابطه با تصمیم گیری در زمینه انگیزه های پذیرش "امور ایمنی" ایفا می نمایند. نتایج همچنین نشان داد که در قیاس با سایر خصوصیات کارخانجات، درجه وسعت فعالیت نقش عمده تری را در پذیرش و بکار گرفتن سیستم های ایمنی غذائی عهده دار هستند. مراکز تهیه محصولات غذایی که دارای ۱۰ تا ۱۴، ۱۵ تا ۲۰ و یا بیش از ۲۰ پرسنل و همچنین به کارگیری مهندس صنایع غذایی و یا دامپزشک به عنوان کادر ثابت بودند در قیاس با مراکزی که دارای پرسنل کمتری بودند احتمال به کار گرفتن سیستم های ایمنی غذائی بیشتری را دارا بودند. تحقیق همچنین نشان می دهد که رابطه نزدیکتری بین بکارگیری سیستم های ایمنی غذائی و دقت در شستشو و بهداشت دستها (در قیاس با مراکزی که کمتر در این رابطه دقت بخرج می دهند) وجود دارد. این مطالعه انعکاس دهنده این است که رابطه آماری مثبت و معنی داری

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بین شستشوی دستها و پذیرش "سیستم های ایمنی غذائی" وجود دارد. اما از جهت دیگر امکان اثبات تاثیر معنی دار مثبتی بین قبول " سیستم های ایمنی غذائی" و عواملی چون: اطلاع از منابع، پذیرش مخاطرات (ریسک پذیری)، وجود ضایعات، تهویه کافی، و همچنین تعداد کارکنان (عادی) و نوع فعالیت (محصول لبنی یا گوشتی) به اثبات نرسید.

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