PRODUCERS' WILLINGNESS-TO-ADOPT HACCP PRINCIPLES IN THE GOAT MEAT INDUSTRY

By

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Abstract:

This paper estimates goat producers' willingness-to-adopt HACCP principles to reduce microbial pathogens in goat meat. Data used are drawn from a food safety education project for small ruminant producers funded by the USDA Food Safety Inspection Services. The data are collected using contingent valuation survey administered among goat producers in Alabama and Tennessee. The probabilities of willingness-to-adopt HACCP practices are estimated using a probit model. The results reveal a diversified set of preferences among goat producers with more than half of the survey sample indicating willingness-to-adopt HACCP principles.

JEL: O140, Q160, Q180, 110

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1. Introduction

The farm structure in the U.S. is continuously changing—modern food is now produced by large farms, processed industrially, and sold in supermarkets and multinational food outlets (Sanders, 1999; Hennessy, Hedberg, Slutsker, White, Besser-Wiek, Moen et al., 1996). Although modern food production has reduced the cost and increased the variety of foods available, this centralization of the food supply has increased the likelihood of food borne pathogens and toxins to infect and poison large numbers of consumers. In the past, progress in combating food borne disease has largely been offset by other global trends, including increasing population (especially in urban areas), growing consumer demand for foods of animal origin, longer food distribution networks and many basic changes in the way food is produced, transported, processed, prepared and consumed (FAO, 2000).

Today, modern food production is so complex that a systematic approach is needed to identify the hazards at each point in the food chain (Sanders, 1999). Globalization has also played a major role in stimulating food safety. Foreign buyers who demand high safety standards tend to test products for safety and pay premiums or guarantee sales for safer producers (ERS 2004). To help identify microbial pathogens and toxins that cause food borne diseases, the U.S. Department of Agriculture has recommended the application of the Hazard Critical Control Point program (HACCP) borrowed from the aerospace industry (Pierson, 1995). The agency requires all meat packers and processors to operate under the HACCP system, a system designed to prevent food safety problems instead of finding problems after they occur (FSIS, 1998; USDA, 1996). The animal producers' responsibility under the packer's HACCP plan is to

supply the packers and processors with animals that are free from antibiotics and chemicals (pesticides), as well as free from physical hazards such as broken needles and other foreign objects.

In an effort to meet this responsibility, larger animal producers' organizations (such as the poultry and beef cattle associations) have successfully incorporated HACCP concepts in the residue avoidance sections of their quality assurance programs (Bailey, Cox and Stern, 1995; Perkins, 1998; Smith, 1999). As a result of producers in the larger industries successfully incorporating HACCP principles in their production operations, the incidence of violative residues in meat and poultry are very low for the overwhelming majority of slaughter classes.[1] However, in the smaller industries (such as the goat meat industry), there has been less or no efforts to incorporate HACCP principles in the production operations. The absence of such principles in the smaller industries poses major risk concerns to the issue of food safety. It is necessary, therefore, to examine the voluntary application of HACCP principles in the small industries. Thus, the focus of this paper is to examine whether or not goat producers in Alabama and adjoining counties in Tennessee are willing to incorporate HACCP principles in their production operations.

[1] The USDA data shows that salmonella prevalence in 1998-2001 dropped in cows and bulls from an average of 2.7% before HAACP implementation to 2.2% after implementation. For steers and heifers, the average fell from 1% to 0.4%; ground beef from 7.5% to 3.4%; ground chicken from 44.6% to 15.7%; and ground turkey from 49.9% to 29.2% (Roybal, 2002).

The rest of the paper is organized into six additional sections. Section 2 defines HAACP and its preliminary steps. Section 3 discusses HACCP's application to animal production. Section 4 presents the data and its description. The analytical model in presented in section 5 followed by the estimated results in section 6. The conclusions are presented in section 7.

2. Defining HACCP

The Hazard Analysis Critical Control Point (HACCP) concept is a systematic approach to the identification, assessment and control of hazards in a particular food operation (Pierson, 1995). HACCP aims at identifying problems before they occur and establish measures for their control at stages in production that are critical to ensuring the safety of the food. Control is proactive, since remedial action is taken in advance of problems occurring. Perhaps the most important part of the HACCP definition is one for Critical Control Point (CCP): a point, step or procedure at which control can be applied and a food safety hazard can be prevented, eliminated, or reduced to an acceptable level. Table 1 shows the preliminary steps and principles necessary for the application of the HACCP concepts.

-------- Table 1 about here --------

3. HACCP Application to Animal Production

While HACCP is well defined in the food processing industry, application to animal production for control of potential food borne pathogens on the farm has not been well researched (Lautner, 1995). As a result, animal producers are being challenged to develop quality control programs of their own. The USDA-FSIS has established an

Animal Production/Preharvest Food Safety Program to work with animal producers and scientists to design and implement measures prior to slaughter (hence the term preharvest) that will improve food safety. Much of this program is focused on controlling risks similarly to the above-described HACCP. Similarly, the live animal segment of the "farm-to-table" continuum holds enormous promise for developing food safety preventive programs based on the HACCP approach. Several interventions at the animal production stage have been proposed for the control of food borne pathogens including animal trace back, replacement progeny, vaccination, environment control, diet, feed/water, competitive exclusion and handling during transport (Pierson, 1995).

These are all possible interventions that could be considered as preventive measures on which CCPs could be based. These interventions, however, need considerable research before they could be applied on a practical basis in a HACCP system for actual animal production. At this time however, HACCP is still a completely voluntary program among animal producers. An example of a voluntary HACCP plan for an animal production operation is the Coleman Natural Meats, Inc. HACCP food safety program, which considers chemical hazards (Rice, 1993). Coleman's HACCP plan covers animal production, slaughter, processing and shipping. The animal production component includes the ranch, live animal shipping, feedlot, shipping to slaughter, and receiving.

4. Why the Goat Meat Industry

The focus of the United States goat industry has shifted from one of primarily fiber production to an emphasis on meat production (Pinkerton, Harwell, Escobar, and

Drinkwater, 1993; Pinkerton, Harwell and Drinkwater, 1994; Pinkerton, 1995). This is because the portion of the American population that has a taste for goat meat appears to be increasing. Domestic slaughter and imports continue to rise annually, and goat meat that was once exported to Mexico, Canada, and the Caribbean is now being consumed in the United States (Miller, 1999). The meat is lean, and may appeal to health-conscious consumers, but the primary purchasers of goat meat are members of ethnic groups, especially Hispanics, Muslims, and various Caribbean and Asian peoples.

These minority populations are beginning to increase in most southern cities and townships including, Nashville in Tennessee, Birmingham and Montgomery in Alabama, and Atlanta in Georgia. The United States Census Bureau projects that by 2050, Hispanics will account for 57 percent of the immigration into the United States, and that Hispanics will account for 25 percent of the U.S. population (United States Census Bureau, 1998). These projections support the notion of an expanding goat meat market; and this adds a new dimension to the issue of food safety. Since the goat meat industry is not impervious to pathogens that cause food borne diseases, early intervention is imperative.

Like other livestock, goats often contract Salmonella and E. coli on the farm and in their feedlots. Pathogens can also be introduced into goat meat in slaughter plants, processing procedures, equipment and facility sanitation, which in turn increase the risk of food borne illness. One way through which goat meat slaughter plants and processors can reduce the likelihood of producing goat meat with high levels of pathogens is if goat producers provide them with livestock that are free of pathogens. Particularly, there have been little or no studies done on food safety in the goat industry. The invisible hazards

and inconsistent information about food borne risks associated with goat meat makes food safety an unpredictable problem that can disrupt markets and cause substantial economic losses for everyone from farm input suppliers to consumers. Thus, efforts to encourage goat producers to adopt production practices that are consistent with the HACCP systems are paramount.

5. Data

Data used are drawn from a food safety education project for goat producers funded by the USDA Food Safety Inspection Services (FSIS). The data are collected using a food safety survey administered among goat producers in Alabama and adjoining counties in Tennessee. The questionnaire was developed and administered under the assumption that goat producers' response to willingness-to-adopt questions is affected by their attitudinal (behavior representing a strong belief) and demographic characteristics. These attitudinal and demographic characteristics shape our unique experiences and may differ notably between producers. Prior to answering the questionnaire, goat producers were provided with a description/definition of HACCP and its use in livestock and poultry processing and slaughtering plants. Producers were also informed that HACCP is a completely voluntary program among animal producers.

The data for the dependent variable are drawn from a question that asked goat producers to indicate whether or not they would be willing to adopt HACCP principles in their production operations. In total, 198 surveys were collected, but only 178 were usable. The list of variables and their definitions are presented in Table 2. The majority of the respondents (58.9 percent) in our sample were male and of white race (51.4 percent). As for age, 26.6 percent of the respondents were between 20-40 years while 45.4 percent

were over 40 years. In reference to education, 28.5 percent had a high school diploma or less while 38.5 percent had a bachelors degree and above. Looking at gross farm income, 53.2 percent of the respondents reported gross farm income levels below $20,000 while 37.6 percent reported gross farm income levels above $20,000. The distribution of the rest of the variables is as shown in Table 2, but overall, the data represent goat producers who are mostly white, male, educated and with fairly low gross farm income.

------- Table 2 about here---------

6. Model

The key issue from a policy perspective is to evaluate the impact of producers' responses in terms of expected behaviors of the goat meat industry on reducing human health risk associated with food borne diseases. As in the majority of cases, it is not possible to preview how each individual producer will behave, it is more reliable to estimate the probability of whether or not a goat producer with some attributes will be willing-to-adopt HACCP practices in his/her production operation. Because the dependent variable (willingness-to-adopt HACCP practices) is discrete in nature and we wish to determine how goat producers' characteristics affect it, we use a probit model.

The probit model assumes that while we only observe the values of 0 and 1 for the variable willingness-to-adopt (WTA), there is a latent, unobserved continuous variable WTA^* that determines the value of WTA. We assume that WTA^* can be specified as,

$$WTA_i^* = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki} + u_i \qquad (1)$$

and that:

$$WTA_i = 1 \text{ if a goat producer is willing-to-adopt HACCP}$$

$$WTA_i = 0 \text{ otherwise}$$

where x_1, x_2, … x_k represent vectors of random variables, and u represents a random disturbance term. Now from equation 1,

$$\Pr(WTA_i = 1) = \Pr(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki} + u_i > 0) \tag{2}$$

Rearranging terms,

$$\begin{aligned}\Pr(WTA_i = 1) &= \Pr(u_i > -(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki})) \\ &= 1 - \Pr(u_i < -(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki})) \\ &= 1 - F(-(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki}))\end{aligned} \tag{3}$$

where F is the cumulative density function of the variable u. If one makes the usual assumption that u is normally distributed, then:

$$\begin{aligned}\Pr(WTA_i = 1) &= 1 - \Phi(-(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki})) \\ &= 1 - \Phi(-\mathbf{x}_i' \beta) \\ &= \Phi(\mathbf{x}_i' \beta)\end{aligned} \tag{4}$$

where Φ represents the cumulative normal distribution function. Then, it follows that the probabilities for each response category are given by:

$$\text{Prob}\left[WTA_i = 0\right] = \Phi\left[\mu_0 - \alpha X\right] \tag{5}$$

$$\text{Prob}\left[WTA_i = 1\right] = \Phi\left[\mu_1 - \alpha X\right] - \Phi\left[\mu_0 - \alpha X\right], \tag{6}$$

with $\alpha = \beta/\sigma$ and $\theta_j / \sigma = 0,1$. Note that only the ratios β/σ and θ_j / σ are estimable (Dustman, 1996).

Using maximum likelihood technique we compute estimates of the coefficients (βs) in equation (1) and their corresponding standard errors that are asymptotically efficient. The corresponding likelihood function is given by:

$$L = \prod_{y_i=0} [F(-\sum \mathbf{x}_i' \beta)] \prod_{y_i=1} [1 - F(-\sum \mathbf{x}_i' \beta)], \tag{7}$$

which can be rewritten as:

$$L = \prod_{y_i=1} [F(-\sum \mathbf{x}_i^{'}\beta)]^{1-y_i} [1 - F(-\sum \mathbf{x}_i^{'}\beta)]^{y_i} \ . \tag{8}$$

Having estimated equation (1) with maximum likelihood (ML) technique, equation (5) basically gives us the probability of obtaining a no-response to the willingness-to-adopt question (Prob[$WTA_i = 0$]), and equations (6) the probability of obtaining a yes-response to the willingness-to-adopt question (Prob[$WTA_i = 1$]).

However, these estimates cannot be interpreted in the same manner we interpret normal regression coefficients. These coefficients give the impact of the independent variables on the latent variable WTA^*, not WTA itself. To transfer WTA^* into a probability estimate for WTA we compute the cumulative normal of WTA^*. Because of this transformation there is no linear relationship between the coefficients and $Pr(WTA_i = 1)$. Hence, the change in $Pr(WTA_i = 1)$ caused by a given change in x_{ji} will depend upon the value of all of the other xs and their corresponding coefficients, or more precisely on the value of the sum $X_i\beta$, as well as the change in x_{ji}.

To estimate the probabilities of a goat producer expressing willingness-to or not-to-adopt HACCP, we specify a model that is linear in parameters as,

$$\begin{aligned} WTA = \alpha_0 &+ \beta_1 \text{Race} + \beta_2 \text{Gender} + \beta_3 \text{Age} + \beta_4 \text{state} + \beta_5 \text{Education} + \\ &\beta_6 \text{Income} + \beta_7 \text{Own} + \beta_8 \text{Farm size} + \beta_9 \text{Experience} + \beta_{10} \text{Marketing} + \\ &\beta_{11} \text{Membership} + \beta_{12} \text{Health practices} + \beta_{13} \text{Operation} + \varepsilon \end{aligned} \tag{9}$$

where α_0 and β_i are parameters to be estimated, and the error term ε is assumed to be independently, and identically distributed. This limited dependent variable model can be estimated using maximum likelihood, probit procedure. The model is estimated using LIMDEP statistical software package (Greene, 2000).

7. Results

The estimated effects are summarized in Table 3. First, demographic characteristics turn out to be significant with respect to race and gender, but not significant with respect to age. The estimated coefficient for race (indicating white) is statistically significant implying that white producers are more likely than black producers to adopt HACCP. If the respondent is male (gender equals one), the probability of expressing willingness-to-adopt HACCP increases. As for age, if the respondent is old (indicating producers who are above 40 years old) the probability of expressing willingness-to-adopt HACCP decreased. This result corresponds to the general tendency that younger people are more critical and liberal than older people. Younger people are also believed to be eager to do things differently and bring forth change compared to the elderly people who are to some extent conservative. It might also be that old producers perceive their experience to be sufficient in ensuring the production of safe animals; implying that old producers are less likely than young producers to see the benefit of HACCP in ensuring the production of safe animals, *ceteris paribus*.

---------- Table 3 about here --------

Looking at the education variable, if education is a proxy for producers' ability to assimilate information and assess potential risks and benefits, then producers with higher levels of education would be more likely to adopt HACCP principles to ensure the safety of the food system. Though the estimated coefficient for less than high school education (*low education*) is positive and significant, the coefficient for more than college

education (*high education*) is highly significant; supporting the above assertion that educated producers would be more likely to adopt HACCP principles to ensure the safety of the food system. This observation concurs with a general consensus that education raises people's general awareness including food safety, security and risks among farmers.

The estimates also show that variables related to farm ownership, farm size and the number of years the respondent has been producing goats exerts downward pressure on producers' willingness-to-adopt HACCP principles. First, farm ownership is insignificant suggesting that whether a producer owns or rents the farm has no influence on willingness-to-adopt HACCP principles. Conversely, farm size and experience in goat production are insignificant determinants of whether or not a goat producer will adopt HACCP principles. Most important is the negative effect of these variables on willingness-to-adopt HACCP principles in goat production. Experienced farmers have a lot of confidence on the way they handle there animals compared to inexperienced farmers. As such, experienced farmers tend to be more rigid in their operations. Similar arguments can be made for the ownership variable where farmers who rent land will be more willing and likely to reduce their risks by implementing risk control and management practices in line with HACCP principles. The negative sign of farm size is an interesting observation since bigger farm sized operations require more organized food handling and security plans compared to small sized farms.

The estimated coefficient for the state dummy variable (Alabama equals one) also suggests that Alabama producers are less likely to adopt HACCP compared to Tennessee producers, but the coefficient is not statistically significant. The dummy variable for the

type of operation (meat goat equals one) is significant and suggests that meat goat producers are more likely than dairy goat producers to adopt HACCP principles; a finding that meets with our expectations. The results also show that marketing techniques, health practices and membership with commodity/farm associations play a significant role in determining whether or not a goat producer will express willingness-to-adopt HACCP principles.

Next, we consider the marginal effects of each independent variable on goat producers' willingness-to or not-to-adopt HACCP principles. The marginal effects (as presented in the last two column of Table 3) help to further understand how the dependent variable is related to the independent variables. These effects are evaluated by assuming that a given respondent has the mean score for every independent variable; in other words, the respondent is average in every way. This technique enables us to isolate the effect of a change in one variable given that all the others remain constant. As depicted in the last two columns of Table 3, gender, race, education, marketing, health practices, membership and low gross farm income are the only variables with significant marginal effects.

The marginal effects associated with the race variable are highly significant suggesting that white producers are more likely to adopt HACCP principles compared to other races. This can be attributed to the fact that minority farmers experience a contingent of socioeconomic factors such as low education and income levels which may influence their perception of food safety and security. Education is another variable with highly significant marginal effect. This finding is in line with our expectations since educated farmers would have the ability to extract information from different sources

without much difficulty due to the knowledge and exposure obtained via education as compared to uneducated farmers. Farmers who sell more than 50 percent of goats on the farm are less likely to adopt HACCP principles compared to those who sell more than 50 percent of their animals to local auction and slaughter plants. Auctions and slaughter plants are more concerns with the health of the animals they purchase or process as compared to individuals who buy goats form individual farmers for family or individual consumption. This explains the negative effect observed for the marketing technique variable.

Also goat producers who experience health or mortality problems in their operations are more likely to adopt HACCP principles and vice verse. This is not surprising since producers who have had difficulties before are aware of the potential dangers and would take precautions. To the contrary, goat producers who have not faced health/mortality problems within their operations may underestimate the potential risks. Similarly farmers who belong to certain producer associations, such as the Goat Producers Association, have more access to food safety and risk management information, and are therefore more likely to adopt HACCP principles compared to those who do not belong to such associations. Gender also has significant marginal effect on willingness-to-adopt HACCP principles. Male farmers have a higher probability to accept HACCP compared to female farmers. This is quite surprising given the fact that women are more aware and concerned about health issues as compared to men. Perhaps this influence could be due to the small number of female goat producers represented in the data sample.

Turning to model performance, the frequencies of actual and predicted outcomes suggest that the model performs relatively well, correctly predicting 77 percent of the total 166 responses analyzed (Table 4). Specifically, the model predicts that 51 (observed: 55) of the goat producers in the total sample are not open to incorporating HACCP principles in their production operations, while 115 goat producers (observed: 111) are open to incorporating HACCP principles in their production operations. The *log likelihood* statistics is also used to test the significance of the model. We observe a *log likelihood* value of -153.809 and a significance level of (.0000) suggesting that the model is highly significant.

------- Table 4 about here --------

8. Conclusions

The paper used survey data, drawn from goat producers in Alabama and adjoining counties in Tennessee, to examine producers' willingness-to or not-to-adopt HACCP principles in their production operations. Data used are drawn from a food safety education project for small ruminant producers funded by the USDA Food Safety Inspection Services (FSIS). The data are collected using contingent valuation survey administered among small ruminant producers in Alabama and Tennessee. The survey results reveal a diversified set of preferences among goat producers where by more than half of the survey sample indicated willingness-to-adopt HACCP principles. Particularly, 31 percent of the respondents were not willing-to-adopt HACCP, while 69 percent were positive.

The probabilities of willingness-to-adopt HACCP practices are estimated using a probit model. Probit results indicated that gender race, education, marketing techniques, health practices and type of operations are the significant determinants of whether or not goat producers will adopt HACCP principles. Positive effects are associated with gender, race, young-age, education, gross farm income, health practices, association membership, and type of operations. Alternatively, negative effects are associated with old-age, owning a farm, farm size, state dummy, experience, and marketing technique. In the event of implementing HACCP principles in goat production, it is necessary to consider the role of each of the above significant variables: race, age, education, gender association memberships, health practices and marketing techniques. More awareness is required, particularly for minority farmers, older farmers, female farmers, farmers who have never experienced health problems before and those who sell their animals mainly on the farm.

Lastly, the major limitation of this study is related to survey data. The main problem in collecting survey data is associated with coverage errors; non response due to lack of cooperation of the respondents, or errors in framing the questions to solicit the needed information; and measurement errors, which may arise as a result of faulty responses due to unclear questions, memory errors, deliberate distortion responses, inappropriate informants, mis-recording of responses, etc.

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Table 1. Steps and principles for the HACCP application

Preliminary Steps	Principles
1. Assemble the HACCP team.	1. Conduct a hazard analysis. Prepare a list of steps in the process where significant hazards occur and describe the preventive measures.
2. Describe the food and the method of its distribution.	2. Identify the CCPs in the process.
3. Identify the intended use and consumers of the food.	3. Establish critical limits for preventive measures associated with each identified CCP.
4. Develop a flow diagram which describes the process.	4. Establish CCP monitoring requirements.
5. Verify the flow diagram.	5. Establish corrective action to be taken when monitoring indicates that there is a deviation from an established critical limit.
	6. Establish effective record-keeping procedures that document the HACCP system.
	7. Establish procedures for verification that the HACCP system is working correctly.

Source: Pierson, 1995

Table 2. Variable definition and sample statistics

Variable		
Dependent Variable: Assessment of willingness to adopt HACCP principles:		
	= 0 if a goat producer is not willing to adopt HACCP principles	
	= 1 if a goat producer is willing to adopt HACCP principles	
Independent Variables:		% of Responses
Gender	= 1 if male; 0 otherwise.	58.9
Race	= 1 if white; 0 otherwise	51.4
Young-age	= 1 if age falls between 20 to 40 years; 0 otherwise	26.6
Old-age	= 2 if age is above 40 years; 0 otherwise	45.4
Low education	= 1 if less than high school; 0 otherwise	28.5
High education	= 1 if college and above; 0 otherwise	38.5
Low gross farm income	= 1 if under $20,000 gross farm income; 0 other wise	53.2
High gross farm income	= 1 if above $20,000 gross farm income; 0 otherwise	37.6
Own farm	= 1 if own the farmland; 0 otherwise.	67.4
Farm size	= 1 if less than 5 acres	25.1
	= 2 if more than 5 acres but less than 10	61.2
	= 3 if more than 10 acres	13.7
State dummy	= 1 if Alabama; 0 otherwise	78.0
Experience	= 1 if less than 1 year of producing goats	5.2
	= 2 if more than 1 year but less than 3 years.	15.0
	= 3 if more than three years	79.8
Marketing technique	= 1 if sold more than 50% of goats on farm	64.6
	= 2 if sold more than 50% of goats to local auction	28.4
	= 3 if sold more than 50% of goats to slaughter plants	7.1
Health practices	= 1 if experience health and mortality problems; 0 otherwise	22.4
Association membership	= 1 if belongs to a commodity/farm association; 0 otherwise	47.3
Type of operation	= 1 if meat goat operation; 0 otherwise	78.4

Table 3. Regression estimates for food safety model

Dependent Variable = Willingness-to-adopt HACCP Principles				
	Probit Estimates		Marginal Effects	
Variable	Coefficient	t-ratio	Coefficient	t-ratio
Constant	0.791**	2.184	0.110**	2.283
Gender	0.336*	1.476	0.108*	1.478
Race	0.569**	2.824	0.168***	2.983
Young-age	0.039	0.333	0.120	0.478
Old-age	-0.324	-1.342	-0.033	-1.379
Low education	0.574**	2.446	0.183**	2.832
High education	0.064***	3.067	0.036**	2.304
Low gross farm income	0.212*	1.496	0.064*	1.706
High gross farm income	0.103	0.348	0.022	0.422
Own	-0.073	-0.524	-0.023	-0.564
Farm size	-0.293	-1.036	-0.041	-1.026
State dummy	-0.019	-0.125	-0.041	-1.253
Experience	-0.291	-1.250	-0.110	-1.039
Marketing technique	-0.858**	-2.171	-0.027**	-2.283
Health practices	0.525**	2.816	0.112**	2.086
Association membership	0.191	1.356	0.003*	1.489
Type of operation	0.234*	1.448	0.065	1.311
Log-L	-153.809			
Model χ^2	42.830			
N	166			

*, **, *** denotes significance at 10%, 5% and 1% levels, respectively.

Table 4. Frequencies of actual and predicted outcomes			
	Predicted		
Actual	0	1	Total
0	34	21	55
1	17	94	111
Total	51	115	166
Model Prediction[a]			77%

a. The predicted percentages are calculated as (predicted/total sample)*100.