KNOWLEDGE, APPLICATION AND ADOPTION OF BEST MANAGEMENT PRACTICES BY CATTLE FARMERS UNDER THE ENVIRONMENTAL QUALITY INCENTIVES PROGRAM - A SEQUENTIAL ANALYSIS

by

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ABSTRACT

This study examines Louisiana farmers' awareness of EQIP and their subsequent adoption of best management practices (BMPs) using a sequential logit model. Results indicate that farmers likely to be aware of EQIP and eventually adopt BMPs under the program were mainly those who had been in contact with NRCS officials.

Key words: BMPs, EQIP, Sequential logit model.

INTRODUCTION

Louisiana accounts for about 1.7% of the total US cattle operations. Producers are encouraged to reduce stream water pollution that results from animal waste, application of agrochemicals and other farming activities by using best management practices (BMPs). Some programs have been implemented to encourage the use of BMPs such as the Environmental Quality Incentives Program (EQIP). This program involves the payment of subsidies to landowners willing to implement specific cost-intensive conservation practices (Vigil et al.). The EQIP works together with other federal programs and is the only program that explicitly targets funds to address livestock production environmental concerns. Nationally, at least 50% of EQIP funds must be used for natural resource concerns related to livestock (Vigil et al.). The question is whether farmers are aware of the existence of the EQIP and, if so, whether they are implementing BMPs using EQIP funds.

Most previous studies involving environmental problems related to agricultural production have focused on factors affecting the adoption of BMPs (e.g. Antle and Diagana; Brannan et al.; Inamdar et al.; Rahelizatovo and Gillespie; Kim et al.) and the awareness of incentive programs (e.g. Feather and Amacher; Ipe et al.; Cooper). Current use of the EQIP to aid farmers in BMP adoption has been described as "modest to meager" (Brewer et al.). This problem may be due to a lack of information about EQIP and the benefits derived from adopting BMPs (Feather and Amacher; Ipe et al.; Cooper; DeVuvst and Ipe); or social isolation (Wilkening).

Some studies have shown that BMP helps to reduce pollution, often at little cost to the farmer, and is more intensive if public supported financial incentives are offered to farmers through programs like EQIP (Taylor et al.). Personnel involved in the administration of the EQIP, the USDA Natural Resource Conservation Service (NRCS), are in contact with farmers and thus play an important role in educating farmers on BMPs. Farmers' perceptions are changed in the educational process, increasing their knowledge of BMPs and of the conservation program.

The objectives of this study are to: (1) determine the proportions of cattle producers in Louisiana who: (a) have no knowledge of EQIP; (b) have knowledge of EQIP but have not applied to the program; (c) have knowledge of EQIP, have applied, but have not been accepted for funding; (d) have knowledge of EQIP, have applied, have been accepted, and did not cancel the program later and (e) have knowledge of EQIP, have applied to the program, have been accepted but canceled the program later; and (2) determine the types of producers who fall into each of these categories.

THE MODEL

The Sequential Logit Model:

The sequential logit model is a discrete choice model. Up to the early 60's, there was no recognized field of statistical theory known as sequential analysis (Johnson). However, a variety of ad hoc sequential sampling methods were constructed in response to many specific problems. The sequential probability ratio test, s.p.r.t, which is based on the likelihood ratio, gave rise to sequential analysis. Recent sequential procedures have been introduced for comparative clinical trials (Whitehead). Other works using sequential analysis have examined sequential designs in nonlinear problems (Hu), the bias of maximum likelihood estimation following a sequential test (Whitehead), group sequential distribution-free methods for the analysis of multivariate observations (Su and Lachin), and simple methods for constructing exact tests for sequentially designed experiments (Andrews and Herzberg). A limitation associated with the sequential logit model is that, in some cases, the sequentially conducted process affects the probability distribution, thus increasing the variance substantially (Whitehead). The number of observations, N, required for an unbiased estimation depends on the explanatory variables, m and the expected pseudo R^2:

$$N > [8(1-R^2) / R^2] + (m-1).$$

Sequential analysis splits continuous variables into more alternatives that can increase m.

The potential gain from sequential analysis can, however, outweigh the losses (Andrews and Herzberg). The sequential logit analysis of this study involves five levels. Each level (except for the first) depends on previous results. Binary logit models are run, where the first level is estimated from the entire sample, then subsequent ones from the sub-sample of the preceding level after eliminating "no" observations. The sequential response probability is then obtained using the results obtained from the series of binary logit model runs. The cumulative distribution function for a logistic distribution is given as:

$$(1)\ P(y_z=1 \mid x'_t) = (F\ \beta' x_z) = \frac{1}{(1+\exp(\beta' x_z))},\text{when } y_z = 1$$

And

$$(2)\ P(y_z=0 \mid x'_t) = (1 - F\ \beta' x_z) = \frac{\exp(\beta' x_z)}{(1+\exp(\beta' x_z))},\ \text{when } y_z = 0$$

where $F(\beta' x_z)$ is the cumulative distribution function with respect to $\beta' x_z$ (Hill et al.). Thus, the actual probability estimates for the sequential response model, P_z, where z= 0, 1, 2, 3, 4, can be represented as follows:

$$(3)\ P_0 = [1-F(\beta' x_1) = \frac{\exp(\beta' x_1)}{1+\exp(\beta' x_1)}$$

(4) $P_1 = F(\beta' x_1)[1 - F(\beta' x_2)] = \frac{1}{1+\exp(\beta' x_1)} * \frac{\exp(\beta' x_2)}{1+\exp(\beta' x_2)}$

(5) $P_2 = F(\beta' x_1)\, F(\beta' x_2)\, [1 - F(\beta' x_3)] = \frac{1}{1+\exp(\beta' x_1)} * \frac{1}{1+\exp(\beta' x_2)} * \frac{\exp(\beta' x_3)}{1+\exp(\beta' x_3)}$

(6) $P_3 = F(\beta' x_1)\, F(\beta' x_2)\, F(\beta' x_3)\, [1 - F(\beta' x_4)]$

$$= \frac{1}{1+\exp(\beta' x_1)} * \frac{1}{1+\exp(\beta' x_2)} * \frac{1}{1+\exp(\beta' x_3)} * \frac{\exp(\beta' x_4)}{1+\exp(\beta' x_4)}$$

(7) $P_4 = F(\beta' x_1)\, F(\beta' x_2)\, F(\beta' x_3)\, F(\beta' x_4)$

$$= \frac{1}{1+\exp(\beta' x_1)} * \frac{1}{1+\exp(\beta' x_2)} * \frac{1}{1+\exp(\beta' x_3)} * \frac{1}{1+\exp(\beta' x_4)}$$

Marginal Effects: To determine the effects of one-unit changes in each of the explanatory variables on the dependent variable, the marginal effects are derived from the probabilities obtained for the sequential logit model. Determining the marginal effect of a dummy variable is different from that of a continuous variable. Let a particular dummy variable at a level, z, be represented by X_z for a binary operation where X_z can take only values 0 and 1. To obtain the marginal effect of X_z at each level z, the actual values of X_z (0 and 1) are plugged into the probability equations (3) to (7) instead of the means and the difference in the resultant values are the marginal effects. For other dummy variables in the models, if their means are less than 0.5, the value 0 replaces the mean. For means greater than or equal to 0.5, the value 1 replaces it. For continuous variables, means are used. Both probabilities are obtained for y_z when x_z=1 and when x_z=0 and the difference between the probabilities gives the marginal effect, ΔP_z (Greene, 2000):

(9) $\Delta P_z = P[y_z \mid x_t = 1] - P[y_z \mid x_t = 0]$

The marginal effects for continuous variables are obtained by taking derivatives of the predicted probabilities for the individual variables (Maddala**):**

Let $P_Z = f(y_z)$, then

$$(10)\ \frac{\partial P_z}{\partial x_z} = \partial f(y_z)$$

Data and Description of Variables

In Summer, 2003, 1,500 Louisiana cattle producers were surveyed to determine their knowledge and use of EQIP, as well as adoption of BMPs. An initial questionnaire was sent to the producers, followed by a postcard reminder two weeks later, and followed by a second questionnaire two weeks after the postcard. Those mailed surveys included farmers with less than 20 animals (26.5%), 20-49 animals (23.5%), 50-99 animals (23.5%), and 100 or more animals (26.5%). Of the surveys sent, 504 were returned completed while 270 were returned incomplete. The adjusted return rate was 41%.

The dependent variables are represented as follows, where $EQIP_z$ represents the dependent variable Y_z at the level z as indicated in equation (1). $EQIP_0$ represents the level where individuals have no knowledge of EQIP. $EQIP_1$ represents the level where individuals have knowledge of EQIP but have not applied to the program. $EQIP_2$ represents the level where individuals have knowledge of EQIP, have applied to the program, but have not received any form of payment. $EQIP_3$ represents the level where individuals have knowledge of EQIP, have applied to the program, have received some form of payment, and have not cancelled the contract. Finally, $EQIP_4$ represents the level where individuals have knowledge of EQIP, have applied to the program, have received some form of payment, but cancelled the contract later. For the logit analyses from which the $EQIP_z$ marginal effects are calculated, the dependent variables used are as follows: KNEQIP represents whether the farmer has knowledge of EQIP. APEQIP represents whether the farmer applied for EQIP funds. PEQIP represents whether the farmer received payment under EQIP. CNEQIP represents whether the farmer canceled EQIP.

Table 1 shows the units and definitions of the explanatory variables and Table 2 gives the expected signs for the logit and sequential models. Expected signs for the variables in the sequential models (Table 2) can be derived using reasoning based on the expected signs of the variables for the logit models. A summary of the descriptive statistics of the explanatory variables for the entire sample of cattle producers completing the questionnaire is given in Table 3. Thus, (1) $EQIP_0$= KNEQIP=0. It is expected that the variables in the model $EQIP_0$ would have signs opposite of those in the KNEQIP model, (2) $EQIP_1$= (KNEQIP=1) (APEQIP=0). It is expected that the variables in the model, $EQIP_1$ would be opposite of those in the APEQIP model, (3) $EQIP_2$= (KNEQIP=1) (APEQIP=1) (PEQIP=0). It is expected that variables in the model $EQIP_2$ would be opposite of those in the PEQIP model, (4) $EQIP_3$= (KNEQIP=1) (APEQIP=1) (PEQIP=1) (CNEQIP=0). It is expected that the variables in the $EQIP_3$ would be opposite in sign to those in the CNEQIP model, and (5) $EQIP_4$= (KNEQIP=1) (APEQIP=1) (PEQIP=1) (CNEQIP=1). It is expected that the variables in $EQIP_3$ would have the same signs as those of the CNEQIP model.

Additional tests carried out in this study were for heteroskedasticity using the Park test, (Hill et al.); and the correlation coefficient, variance inflation factors and the Collins test to determine whether multicollinearity existed (Kennedy).

RESULTS AND DISCUSION

Using the Park test, results obtained for the model KNEQIP showed P-values greater than 0.10, indicating that heteroskedasticity was not detected at either the 5% or 10% levels. The same outcome is, thus, expected for the remaining models. Multicollinearity was not found to be problematic using correlation coefficients and the variance inflation factors. However, using the Collins test, the values for one variable, MALE, in each equation, was greater than 20. However, Belsky et al. suggested that condition indexes (CI) of greater than 100 are the greatest threat to variance inflation and, thus, to regression estimates. Since these CI values were less than 100 and all variables were believed to be important for the economic analysis, they were left in the model and analyzed.

Non-Sequential Model Results (Logit)

Results indicate that 49% of the cattle farmers in Louisiana had no knowledge of EQIP while 51% of them had knowledge of EQIP. The percentage correctly predicted for KNEQIP was 64.5%. Of the 228 farmers who had knowledge of EQIP, 43% had not applied to EQIP and 55% had applied to the program. The percentage correctly predicted for APEQIP was 64.30%. Results indicate that of the 224 farmers who applied to the EQIP, 32% of them did not receive EQIP funds, while 68% did. Percentage correctly predicted for PEQIP was 71.7%, in spite of the general lack of significance of explanatory variables. Of the 138 farmers who received EQIP funding, 82% did not cancel the program and 9% cancelled EQIP after being accepted to the program. The pseudo R-square values indicate the model fits. The binary logit models had relatively low pseudo R-squared values, which is rather common for logistic regressions (Onianwa et al.). The pseudo R-squared values for the models, KNEQIP, APEQIP, PEQIP and CNEQIP are 0.14, 0.12, 0.07, and 0.13, respectively.

Sequential Model Results

Tables 4 to 8 display the sequential model results.

Probability of Farmers Having No Knowledge of EQIP: Table 4 gives a description of the parameter estimates for the sequential response model $EQIP_0 \approx$ (KNEQIP=0). The results indicate that the probability of a farmer not being aware of EQIP decreases for those farmers who have had contact with NRCS and/or LCES officials at least four times in 2002, are diversified, whose farms have been declared "highly erodible" by NRCS and for farmers who operate beef cattle farms on larger tracts of land. All signs on significant variables were as expected.

Probability of Farmers Having Knowledge of EQIP but Not Applying: Four of the explanatory variables in the sequential model equation, $EQIP_1 \approx$ (KNEQIP=1, APEQIP=0) (Table 5), NRCS, HS, HELA, LCES and DIVERSE, were found to be significant at the 0.05 and 0.10 significant levels. This suggests that farmers who have had contact with NRCS and /or LCES officials at least 4 times in 2002, are holders of a high school diploma and whose farms have been declared "highly erodible" by NRCS and have knowledge of EQIP are more likely to apply for EQIP funds. On the other hand, more diversified farmers having knowledge of EQIP are less likely to apply to the program.

Probability of Farmers Having Knowledge of EQIP, Applying but Not Receiving EQIP Funding: The results obtained for $EQIP_2 \approx$ (KNEQIP=1, APEQIP=1, PEQIP=0) (Table 6), showed one explanatory variable, NRCS, being significant at the 0.05 level of significance. This suggests that applying farmers, who had contact with NRCS at least 4 times in the year 2002, were more likely to receive EQIP funding.

Probability of Farmers Having Knowledge of EQIP, Applying, Receiving Payment and Not Canceling EQIP

Table 7 gives the marginal effects for the independent variables for the sequential model equation, $EQIP_3 \approx$ (KNEQIP=1, APEQIP=1, PEQIP=1, CNEQIP=0). However, none of the variables were found to be significant.

Probability of Farmers Having Knowledge of EQIP, Applying, Receiving Payment, but Canceling EQIP: None of the explanatory variable was found to be significant for the sequential model $EQIP_4 \approx$ (KNEQIP=1, APEQIP=1, PEQIP=1, CNEQIP=1) (Table 8).

Results also indicate that, of the 504 cattle farmers who completed the survey questionnaire, 48.1% of the farmers had no knowledge of EQIP, 29.8% had knowledge of EQIP but did not apply to the program, 15.2% of farmers had knowledge of EQIP, applied to the program but did not receive payment, 0.3% had knowledge of EQIP, applied, received payment and did not cancel the program later, and 6.6% of them had knowledge of EQIP, applied to the program, received payment and canceled the program later.

DISCUSSION

Educational programs for EQIP are conducted by NRCS via flyers, newsletters, public meetings, public notices, word of mouth, etc. This targets all agricultural producer groups.

Based on the Louisiana ranking form used to determine whom receives EQIP funding, farmers most likely to receive EQIP would include farmers whose lands: (1) are within the drainage area of a water body that has been designated by the state water quality management plan, (2) consist predominantly of soil with a surface layer K factor equal to or greater than 0.43 and (3) are within a parish listed as a significantly threatened and endangered species habitat. Three additional factors include: (4) Planned treatment would assist the farmer in complying with federal or state environmental laws, (5) the practice is environmentally beneficial, and (6) the farmer has participated in a master farmer program. It was not surprising that, for the sequential model $EQIP_1$, farmers who had contact with NRCS and /or LCES officials at least 4 times in 2002, held high school diplomas, or whose farmlands had been declared "highly erodible" had higher probabilities of applying to the EQIP program. That farmers holding high school diplomas were more likely to apply to EQIP was also consistent with Katchova and Miranda's findings that educated farmers were more likely to enter into marketing contracts, Cooper and Keim results which indicated that more educated farmers were more likely to adopt water quality protection practices, and Ersado et al.'s findings that more educated farmers were more likely to adopt productive and land enhancing technologies.

Selection of farmers for the EQIP program is based on the environmental benefits and cost effectiveness of the BMP to be implemented. Results suggest that, farmers who have had contact with NRCS officials and were, thus, likely to be more informed on whether and how to apply to the EQIP had a higher probability of acceptance.

Other variables that were considered important in the study, RSTRM, AGE and LOWNED were not found to be significant in any of the models. However, Cooper and Keim indicated that farmers who owned greater portions of their land were less likely to adopt BMPs, while Ersado et al. indicated otherwise. Ersado et al., Foltz and Chang, Katchova and Miranda; Kim et al., and Rahelizatovo and Gillespie indicated that older farmers are more likely to adopt BMPs, while Key and McBride indicated otherwise.

SUMMARY AND CONCLUSION

In this study, we modeled the awareness of the EQIP program by cattle farmers in Louisiana and their subsequent adoption of BMPs under the program using data from a survey carried out in 2003 by Kim et al. This survey involved 1,500 cattle producers in Louisiana to determine their knowledge of EQIP and adoption of BMPs. A sequential logit model is used, providing useful estimates which were consistent with other studies.

The results obtained indicate that, of the 504 cattle farmers who completed the survey, 48.1% of the farmers had no knowledge of EQIP, 29.8% had knowledge of EQIP but did not apply to the program, 15.2% of farmers had knowledge of EQIP, applied to the program but did not receive payment, 0.3% had knowledge of EQIP, applied to the program, received payment and did not cancel the program later, and 6.6% of them had knowledge of EQIP, applied to the program, received payment and canceled the program later.

Results indicate that farmers who had contact with NRCS and/or LCES officials at least four times in 2002, diversified farmers, whose farms had been declared “highly erodible” by NRCS, who had a greater portion of their household income coming from beef production, and who operated larger sized cattle farms were more likely to be aware of the EQIP and apply to the program. NRCS has been given the authority to administer the program; further funding of education for NRCS would likely increase adoption rates. The Louisiana Cooperative Extension Service also served as a source of information, but without the authority to administer EQIP, no significant results were found beyond the knowledge of EQIP. In 2003, officials who administer the EQIP informed producers of the conservation provisions of the 2002 Farm Bill. The result was that ranchers and farmers applied for funding, resulting in significant backlogs in all programs (Marcantel).

A significant number of farmers whose lands had been declared “highly erodible’ by NRCS, according to the results obtained, had knowledge of EQIP, applied to the program and adopted BMPs under EQIP. This buttresses the fact that, since NRCS has been authorized to administer the EQIP, the more contacts they make with farmers significantly affects their awareness of EQIP and their subsequent adoption of BMPs under EQIP.

Producers on cattle farms that had streams flowing through them were not found to be more aware or to more likely eventual adopt BMPs under EQIP. Agricultural production has been identified as a major cause of water pollution in the United States (Feinerman et al., Taylor et al., Kaplan et al., Peterson and Boisvert). The movement of byproducts from farming practices to waterways, across fields, makes it difficult to identify the individual sources (Taylor et al.). In order to reduce or eliminate agricultural run-off, farmers close to or miles away from streams should be made aware of the EQIP and encouraged to adopt BMPs.

According to Fienerman et al., farmers who own large portions of their farmlands, run larger cattle operations and receive larger percentages of their net household income from beef production had more knowledge of BMPs and were more likely to adopt it. It would be beneficial to the EQIP if these groups of farmers are kept in the program. They would serve as informants and role models to new farmers (Taylor et al.).

From the results obtained, farmers who hold high school diplomas were more likely to apply to the EQIP. This is not surprising, given past studies that have shown more highly educated farmers to be the greater adopters of technology.

The sequential logit analysis happen to be the best model for this study because it does not exhibit Individual irrelevance alternatives (IIA) and is an improvement on conditional analysis.

Further studies might involve carrying out similar analysis in other states in order to get a better picture of how many cattle producers in the United States are aware of the EQIP and their subsequent adoption of BMPs. Resources might be placed into developing soft wares that can more readily conduct sequential logit analysis. The sequential analysis was calculated by hand after obtaining the logit model results, making it tedious. It is hoped that a program would be developed that can calculate sequential analysis problems more accurately, thus eliminating errors and also saving time.

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LIST OF TABLES

Table 1: Summary of Units and Definitions of the Explanatory Variables

Variable	units	Definition
LOWNED	ratio	Land owned by farmer
NRCS	0-1 (dummy)	Number of times a farmer met with NRCS officials in 2002, 1 = ≥ 4 times and 0 = 0-3 times
FARMSTRM	0-1 (dummy)	How close the farm is to a stream, 1= ≤ 1mile and 0= > 1mile
NAGE	years	Age of the farmer
HS	0-1 (dummy)	Level of farmers education: 0= no high school diploma 1= high school diploma or higher
PBEEFINC	%	Percentage of net household income that comes from the beef production
DIVERSE	1-7	Number of enterprises owned by the farmer
LCES	0-1 (dummy)	Number of times a farmer met with LCES agents in 2002, 1=more than 4 times and 0= otherwise.
HELA	0-1 (dummy)	1 = land has been declared "highly erodible" by NRCS 0 = land has not been declared "highly erodible" by NRCS
NFARMAC	Acres/100	Total acres of land used in cattle operation, divided by 100
MALE	0-1 (dummy)	0=Female 1= Male

Table 2: Summary the Expected Signs of Explanatory Variables for the Sequential and the Logit Models

Variable	units	KNEQIP	APEQIP	PEQIP	CNEQIP	$EQIP_0$	$EQIP_1$	$EQIP_2$	$EQIP_3$	$EQIP_4$
LOWNED	ratio	+	+	?	+	-	-	?	-	+
NRCS	0-1 (dummy)	+	+	+	-	-	-	-	+	-
FARMSTRM	0-1 (dummy)	+	+	+	-	-	-	-	+	-
NAGE	years	+	-	?	?	-	-	?	?	?
HS	0-1 (dummy)	+	+	?	-	-	-	?	+	-
PBEEFINC	%	+	+	?	-	-	-	?	?	-
DIVERSE	1-7	+	+	+	-	-	-	-	+	-
LCES	0-1 (dummy)	+	+	?	-	-	-	?	?	-
HELA	0-1 (dummy)	+	+	+	_	-	-	-	+	-
NFARMAC	Acres/100	+	+	?	+	-	-	?	?	+
MALE	**0-1 (dummy)**	?	?	?	?	?	?	?	?	?

Table 3: Descriptive Statistics of the Entire Sample (KNEQIP)

Variable	Mean	Std.Dev.	Minimum	Maximum
LOWNED	0.68	0.38	0.00	1.0
NRCS	0.09	0.28	0.00	1.0
FARMSTRM	0.71	0.46	0.00	1.0
NAGE	5.86	1.25	2.30	8.7
HS	0.88	0.33	0.00	1.0
PBEEFINC	1.29	0.82	0.00	5.0
DIVERSE	1.04	1.07	0.00	7.0
LCES	0.14	0.35	0.00	1.0
HELA	0.06	0.24	0.00	1.0
NFARMAC	3.77	7.87	0.01	120.0
MALE	0.95	0.21	0.00	1.0

Number of observations, N = 504.

Table 4: Sequential Parameter Estimates ($EQIP_0$)

$EQIP_0$ = KNEQIP=0			
Variable	**ME0**	**S. error0**	**t-stat0**
Constant	0.5393	0.2152	2.5056**
LOWNED	-0.0706	0.0756	-0.9338
NRCS	-0.4544	0.0771	-5.8936**
FARMSTRM	0.0098	0.0549	0.1793
HELA	-0.3972	0.0527	-7.5421**
HS	-0.0238	0.0874	-0.2722
PBEEFINC	-0.0196	0.0413	-0.4745
DIVERSE	-0.0540	0.0282	-1.9195**
LCES	-0.2563	0.0497	-5.1543**
NFARMAC	-0.0139	0.0074	-1.8849**
NAGE	-0.0042	0.0221	-0.1908
MALE	-0.1259	0.1164	-1.0824

ME: marginal effect df=9
S. error: standard error
t-stat: t-statistic. t-critical: 0.05** level =1.833 , 0.10 level = 1.383
(source: generated using the SAS function TINV)

Table 5: Sequential Parameter Estimates ($EQIP_1$)

$EQIP_1$ = (KNEQIP=1 APEQIP=0)			
Variable	**ME1**	**S. error1**	**t-stat1**
Constant	-0.0326	0.2152	-0.1510
LOWNED	0.0083	0.0756	0.1091
NRCS	-0.1353	0.0771	-1.7540**
FARMSTRM	-0.0672	0.0549	-1.2250
HELA	-0.1340	0.0527	-2.5450**
HS	-0.1262	0.0874	-1.4430*
PBEEFINC	-0.0470	0.0413	-1.1370
DIVERSE	0.0421	0.0282	1.4948*
LCES	-0.0991	0.0497	-1.9930**
NFARMAC	0.0093	0.0074	1.2654
NAGE	-0.0089	0.0221	-0.4040
MALE	-0.0400	0.1163	-0.3440

ME: marginal effect df = 9
S. error: standard error
t-stat: t-statistic
t-critical : 0.05** level =1.833 , 0.10 level = 1.383
(Source: generated using the SAS function TINV)

Table 6: Sequential Parameter Estimates ($EQIP_2$)

$EQIP_2$ = (KNEQIP=1 APEQIP=1 PEQIP=0)			
Variable	**ME2**	**S. error2**	**t-stat2**
Constant	-0.0554	0.3875	-0.1430
LOWNED	-0.0163	0.1139	-0.1430
NRCS	-0.1414	0.0654	-2.1610**
FARMSTRM	0.0289	0.0758	0.3811
HELA	-0.0126	0.0757	-0.1670
HS	0.0819	0.1009	0.8113
PBEEFINC	0.0021	0.0582	0.0368
DIVERSE	-0.0151	0.0371	-0.4070
LCES	-0.0710	0.0794	-0.8950
NFARMAC	-0.0024	0.0046	-0.5270
NAGE	0.0133	0.0339	0.3923

ME: marginal effect df = 8
S. error: standard error
t-stat: t-statistic.
t-critical : 0.05** level =1.860 , 0.10 level = 1.397
(Source: generated using the SAS function TINV)

Table 7: Sequential Parameter Estimates ($EQIP_0$)

EQIP$_3$ = (KNEQIP=1 APEQIP=1 PEQIP=0)			
Variable	**ME3**	**S. error3**	**t-stat3**
Constant	-7.33E-06	0.275584	-3E-05
LOWNED	-1.59E-05	0.119405	-0.0001
NRCS	-1.39E-03	0.085762	-0.0160
FARMSTRM	2.73E-05	0.090734	0.0003
HELA	-1.00E-03	0.082211	-0.0120
HS	1.07E-03	0.118758	0.0090
PBEEFINC	4.15E-05	0.092729	0.0004
DIVERSE	9.33E-06	0.042197	0.0002
LCES	-3.88E-03	0.090267	-0.0430
NFARMAC	8.13E-06	0.007731	0.0011
NAGE	3.88E-06	0.034605	0.0001

ME: marginal effect df = 8
S. error: standard error
t-stat: t-statistic. t-critical : 0.05** level =1.860, 0.10* level = 1.397
(Source: generated using the SAS function TINV)

Table 8: Sequential Parameter Estimates (EQIP$_4$)

EQIP$_4$ = (KNEQIP=1 APEQIP=1 PEQIP=1)			
Variable	**ME4**	**S. error4**	**t-stat4**
Constant	-0.0278	1563.6490	-0.000020
LOWNED	-0.0118	71.8516	-0.000200
NRCS	-0.0515	63.4695	-0.000800
FARMSTRM	0.0448	42.1528	0.001100
HELA	-0.0435	58.4054	-0.000700
HS	0.0195	58.2024	0.000300
PBEEFINC	-0.0084	1699.4490	-0.000005
DIVERSE	-0.0037	31.8566	-0.000100
LCES	-0.0725	19.8034	-0.004000
NFARMAC	-0.0002	26.0608	-0.000009
NAGE	0.0072	9.0881	0.000800

ME: marginal effect df =8
S. error: standard error
t-stat: t-statistic. t-critical : 0.05** level =1.860 , 0.10 level = 1.397
(Source: generated using the SAS function TINV)