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Awareness of and Application to the Environmental Quality Incentives Program By Cow–Calf Producers

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This study uses a bivariate probit model with partial observability to examine Louisiana beef producers' awareness of the Environmental Quality Incentives Program (EQIP) and how awareness translates to application to the program. Results indicate that awareness of and application to the EQIP depend on portion of income derived from off-farm sources, extent of previous best management practice adoption at one's own expense, household income, farmed land that is highly erodible, contact with Natural Resource Conservation Service and extension service personnel, and producer age.

Key Words: BMPs, bivariate probit, EQIP, probit

JEL Classifications: Q12, Q16, Q18

With the introduction of the 1985 Farm Bill, a new era of increased emphasis on government conservation initiatives for agricultural land was begun. Among the more recent initiatives introduced in the 1996 Farm Bill and expanded in the 2002 Farm Bill was the Environmental Quality Incentives Program (EQIP). The EQIP involves the payment of subsidies, mainly in the form of cost-shares, to landowners willing to implement specific cost-intensive conservation practices, or best management practices (BMPs). Adoption of these BMPs is intended to reduce runoff of sediment and nutrients into water bodies and seepage of pollutants into groundwater.

The EQIP works together with other federal programs and is the only program that explicitly targets funds to livestock production environmental concerns. Nationally, at least 60% of EQIP funds must be used for natural resource concerns related to livestock (Vigil et al.). Producers may receive up to a 75% cost share on the adoption of qualified BMPs; the limit is 90% for limited-resource or beginning farmers. Despite information provided by federal agencies such as the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) and more recently by extension services through programs such as the Master Farmer Program, many producers are not extensively informed about BMPs (Gillespie, Kim, and Paudel). Given the role of EQIP in encouraging BMP adoption, it is likely that they are also unaware of EQIP, which may help to explain why many are not applying for EQIP funds. Therefore, the objectives of this paper are to determine the extent of cow–calf producers' awareness of and application to the EQIP, factors affecting their awareness of and

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application to the EQIP, and secondarily, to determine factors affecting cow–calf producers' BMP adoption at their own expense.

Understanding the portions of farmers aware of the EQIP and the types is of interest for several reasons. First and clearest is that if a farmer is unaware of a program, he cannot participate. In some cases, without EQIP, a high cost of adoption may prevent adoption of BMPs that have the societal benefits of higher air and water quality. Knowing who is unaware of the program can thus help in targeting educational programs that inform producers of the opportunity. Awareness, however, does not necessarily lead to application. Knowledge of who applies provides insight into the types of producers who believe EQIP will benefit them the most. If, for example, larger farmers on more highly erodible land were the greater applicants, then this would provide evidence that the program is most attractive to producers whose use of BMPs may have the greatest impact on environmental quality.

A number of studies have focused on factors affecting BMP adoption among producers (e.g., Gould, Saupe, and Klemme; Lambert et al.; Rahelizatovo and Gillespie; Soule, Tegene, and Wiebe; Wu and Babcock; Wu et al.) and participation in conservation incentive programs (e.g., Lambert et al.). Few, if any, however, have linked awareness with whether benefits were applied for, especially regarding the EQIP. Though this paper does not link the EQIP to the adoption of specific BMPs, its contribution is that it provides insight into the types of producers who are most likely to be proactive in seeking assistance to adopt BMPs. Use of the EQIP to aid farmers in BMP adoption has been described as "modest to meager" (Brewer et al.).

Should Cow–Calf Producers Be Expected to Know about and Apply for the EQIP?

The "modest to meager" use of the EQIP among agricultural producers in general may be due to a lack of information about the EQIP and the benefits derived from adopting BMPs (DeVuyst and Ipe). Feather and Amacher have discussed the role of information in encouraging producer adoption of BMPs. Wilkening discussed social isolation as a barrier to adoption.

Cow–calf producers may be particularly unlikely to be aware of or interested in application to programs such as the EQIP. Operation size helps in explaining this. In 2004, 91% of Louisiana's cattle producers had fewer than 100 animals (USDA National Agricultural Statistics Service). These proportions of small versus large operations are similar to those of several other states, especially those in the southeastern United States. Cow–calf production requires a relatively low investment in fixed assets on a per-unit basis compared with most other major agricultural enterprises, particularly livestock (Gillespie et al.). The relatively low initial investment requirement along with nonextensive size economies attract producers who are in the business with a variety of motivations, with maintaining and conserving land being the most important goal for the "average" producer (as contrasted with increasing profit for dairy farmers) (Basarir and Gillespie). Although this goal structure should encourage land stewardship, it would likely lead to less interest in government farm programs that affect profitability. Furthermore, cow–calf production has not historically been the beneficiary of a wide array of U.S. farm programs, as no price support program has been in place.

The primary benefit of BMP use is reduction of pollutant runoff and seepage into groundwater. From the cow–calf producer's standpoint, use of BMPs does not necessarily increase yield and associated return. Furthermore, cow–calf pasture-based grazing is not covered by concentrated animal feeding operation (CAFO) and animal feeding operation (AFO) regulations, as animals are not typically confined for a time period necessary to be considered as an AFO under the Clean Water Act. As a result, these operations have not been regulated by the U.S. Environmental Protection Agency and are not assigned permits under the pollution discharge emission system. Having come under relatively little

scrutiny from a regulatory standpoint, cow–calf producers would have less incentive to adopt BMPs than would CAFO or AFO producers. Cow–calf producers must, therefore, see significant conservation or economic benefits (or both) to BMPs to adopt. Thus, despite the significant opportunity for cattle producers to benefit from a program that is targeted to livestock producers, there are several reasons why they may be expected to be less aware of or interested in applying to the EQIP than other producers.

Conceptual Model

Producer awareness of a program may be assumed to be determined primarily by incentives to seek information in the subject area. Producer awareness of programs that are specific to a particular industry depends upon the incentive of the producer to inform himself or herself about industry issues and the physical and mental ability to access information. Awareness of the EQIP is hypothesized to be determined as shown in Equation (1):

$$(1) \quad \textit{Aware of EQIP} = f(m, f, l, i)$$

Incentives and ability to access information may be measured through management and profit indicators, m, such as size, education and experience; financial situation, f, such as income sources; land descriptors, l, such as whether the land is highly erodible; and information sources, i, such as contact with agencies that disseminate EQIP information. An individual would clearly have to be aware of a program's existence before he or she would apply to it. Thus, application would be dependent upon awareness.

For the producer who is aware of a program such as EQIP, application to the program depends upon its effect on producer utility. Expanded from the Cooper and Keim framework, the producer will apply if:

$$(2) \quad \begin{aligned} &U(0, R_0 - C_0, m, f, l, i) \\ &\quad \leq U(1, R_1 - C_1 + CS, m, f, l, i), \end{aligned}$$

where $U(.)$ is the utility operator; (0, 1) represents (nonapplication, application); R represents revenue associated with the enterprise; C represents expected cost associated with the enterprise, where C_1 would also include transaction costs associated with the application process; and CS is the cost-share associated with adoption. This suggests that adoption is a function of profitability associated with the BMP; management and financial considerations, such as how adoption will affect labor allocation; information such as the extent of knowledge held about the program and BMP; and demographic variables. Thus, application for EQIP funds follows:

$$(3) \quad \textit{Apply for EQIP} = f(m, f, l, i)$$

Apply for EQIP is a dummy variable referring to whether or not the individual applies for EQIP funds.

Data and Methods

Mail Survey Questionnaire

During summer 2003, 1,500 Louisiana cow–calf producers were surveyed via mail to determine their awareness and use of EQIP and adoption of BMPs. Following Dillman's tailored design method, an initial questionnaire was sent to the producers, followed by a postcard reminder 2 weeks later, subsequently followed by a second questionnaire 2 weeks after the postcard. The stratified sample drawn via the USDA National Agricultural Statistics Service included cattle producers with <20 animals (26.5%), 20–49 animals (23.5%), 50–99 animals (23.5%), and ≥100 animals (26.5%). Of the surveys mailed, 504 were returned complete. The return rate, adjusted for those no longer in the business or incorrect addresses, was 41%.

Two questions were asked dealing with awareness of and application for EQIP funds. The first was, "Are you aware that you can apply through the Environmental Quality Incentives Program (EQIP) for cost share payments and/or incentive payments when you implement conservation practices (such

as BMPs)?" Respondents were to check "Yes" or "No." Those who answered "Yes" were then asked, "Have you ever applied for cost-share payments and/or incentive payments through EQIP for the adoption of one or more BMPs?" Respondents were to check "Yes" or "No." Farmers were also asked whether they had adopted each of 18 BMPs and, if so, whether they had done so at their own expense, with a cost-share or with an incentive payment. Remaining questions in the survey dealt with farm structure and management, opinions regarding government programs, and demographic and financial information.

Econometric Methods

A bivariate probit model was utilized to analyze the *Aware of EQIP* and *Apply for EQIP* Equations (1) and (3). Generally, the bivariate probit model involves two binary dependent variables y_i, $i = 1, 2$, of which each is a probit equation:

$$(4) \quad Y_1 = \alpha_0 + \alpha_1 X_1 + \varepsilon_1$$

$$(5) \quad Y_2 = \beta_0 + \beta_1 X_2 + \varepsilon_2,$$

where X_1 and X_2 are the vectors of explanatory variables consistent with Equations (1) and (3), respectively; α_i and β_i are the parameters to be estimated; and ε_1, ε_2 are normally distributed error terms, not necessarily independent of one another, such that $E(\varepsilon_1) = E(\varepsilon_2) = 0$, $Var(\varepsilon_1) = Var(\varepsilon_2) = 1$, and $Cov(\varepsilon_1, \varepsilon_2) = \rho \neq 0$.

Partial observability, discussed by Meng and Schmidt, was considered in this model where $y_1 = 1$ if reported value $y_1^* > 0$ and $y_2 = 1$ if $y_2^* > 0$ and $y_1 = 1$. The probability of being aware is $P(y_1 = 1) = \Phi(x'_1\beta_1)$, where Φ is the cumulative density function of the standard normal distribution. The joint probability that the producer is both aware of and has applied to the EQIP is $P(y_1 = 1, y_2 = 1) = \Phi_2(x'_1\beta_1, x'_2\beta_2, \rho)$, where Φ_2 is the bivariate standard normal distribution and ρ is the correlation between ε_1 and ε_2. Bivariate probit with partial observability was used in a policy study by Giulietti, Price, and Waterson, examining in the first stage awareness of a policy change to allow British consumers to switch to other natural gas providers, and in the second stage whether they switched. It was also used in an agricultural technology adoption study by Dimara and Skuras.

Independent variables in the bivariate probit model deal with management and financial considerations and information. Producers are generally expected to have heard of government programs and subsequently applied if they are better managers, if government programs are financially beneficial, and if they are more informed. Few studies have been conducted analyzing farmers' awareness of or participation in government programs, with two examining Conservation Reserve Program (CRP) participation by limited-resource farmers (McLean-Meyinsse, Hui, and Joseph; Onianwa et al.). Though it is recognized that the population of cow–calf producers is likely to differ from that of limited-resource farmers, these studies provide insights for expected signs, especially when coupled with results from BMP adoption studies among the general farm population.

Independent Variables—Management and Financial Considerations

This section discusses variables that consider management and financial considerations of the farm, *m* and *f*, respectively in Equations (1)–(3). Producers running larger farm operations are expected to be more aware of the EQIP and to have more likely applied for EQIP funds. Lambert et al. found larger producers to be greater participants in a working-land program, and Onianwa et al. found larger limited-resource producers to be greater participants in agricultural cost-share programs. Larger producers have generally been the greater technology adopters (Feder, Just, and Zilberman), as they could spread adoption costs over greater output, reducing average total costs. Reduction of average total costs, holding output price fixed, leads to greater net return. On the basis of these studies, larger producers, measured as the number of farm acres operated (*FARM-*

ACRES), are expected to have greater awareness of and be more likely to apply for EQIP funds.

Whether more than half of the producer's net farm income came from nonfarming sources (*OFFFARM*), the number of enterprises other than beef on the farm (*DIVERSE*), and the percentage of total household income from the beef operation (*%INCBEEF*) are measures of the importance of the beef operation to the household and diversification. McLean-Meyinsse, Hui, and Joseph found that full-time limited-resource producers were more likely to participate in the CRP. Lichtenberg found that producers with greater percentages of income from the farm were the greater adopters of three BMPs. Thus, producers with greater percentages of income from the farm are expected to be more aware of and more likely to apply for EQIP funds. On the other hand, producers whose operations are more diversified are expected to have greater awareness of government programs, as collecting information on a greater number of farm enterprises would increase knowledge of and subsequent application for programs useful to multiple enterprises, such as the EQIP. Thus, more diversified producers are expected to have greater awareness of and to be more likely to apply for EQIP funds. Finally, *%INCBEEF* is included to examine the influence of the importance of the beef enterprise on awareness and application to the EQIP. On one hand, since livestock has been targeted for 60% of EQIP funds, producers whose beef operations provide larger percentages of their household income would be expected to have greater awareness and to apply for funds, especially if their other enterprises are primarily crops, as would likely be the case in the Delta farming regions of Louisiana. On the other hand, if cow–calf producers are less motivated by profit than producers of other commodities, as suggested by Basarir and Gillespie, they would be less likely to be aware of and apply for EQIP funds.

Variable *NUMBMPS* is the number of BMPs, from a list of 18, previously adopted by farmers at their own expense. (The 18 BMPs are listed by the Louisiana State University Agricultural Center [LSU AgCenter] Publication 2884 as particularly useful for cattle production.) On one hand, producers who had adopted BMPs extensively at their own expense would have less incentive to apply for EQIP funds since BMPs were already established. Alternatively, if previous adopters (those not having adopted all 18 of the BMPs) have a greater interest in adopting BMPs or view nonadopted BMPs as complementary to existing ones, then they would be expected to be more aware of and to be greater participants in EQIP. The relationship is, thus, examined. Potential endogeneity of this variable is tested using an instrumental variable, as discussed by Bollen, Guilkey, and Mroz. The equation used for testing this variable is estimated using negative binomial regression, which is suitable for count data such as these.

Producers who own greater percentages of their farmland have a greater incentive to adopt soil-conserving BMPs, as they are able to reap the long-run benefits of land-improving investments. Lambert et al. and Lichtenberg found positive relationships between land ownership and BMP adoption (though Rahelizatovo and Gillespie, and Soule, Tegene, and Wiebe found the opposite). Likewise, landowners are expected to have greater incentive to inform themselves of and participate in government programs from which they may benefit. Onianwa et al. found a positive relationship between land ownership and cost-share program participation among limited-resource producers. Thus, producers who own greater percentages of their land (*LOWNED*) are expected to have greater awareness of and to be more likely to apply for EQIP funds.

It is expected that producers with greater net household income (from all sources, farm and nonfarm), *INCOME*, will be more aware of and more likely to apply for EQIP funds. McLean-Meyinsse, Hui, and Joseph found that, of limited-resource producers, those with higher incomes had greater awareness of the CRP. Gould, Saupe, and Klemme found higher income producers to be greater adopters of conservation tillage.

Two demographic variables are included: producer age (*AGE*), which is divided by 10 for estimation purposes; and whether the producer holds a 4-year college degree (*COLLEGE*). McLean-Meyinsse, Hui, and Joseph, and Onianwa et al. found older producers to be the greater participants in the CRP and cost-share programs, respectively. Older producers, however, have been lower adopters of technology in general (Feder, Just and Zilberman) and BMPs specifically (Gould, Saupe, and Klemme; Lichtenberg; Rahelizatovo and Gillespie). Older producers are likely to have greater experience and shorter time horizons as they near retirement. Thus, the influence of age on awareness of and application to EQIP is explored.

Producers with more formal education are expected to be better managers and, thus, to have greater awareness of and to be more likely to apply for agricultural programs. Among limited-resource producers, McLean-Meyinsse, Hui, and Joseph found high school graduates to have greater awareness of the CRP, and Onianwa et al. found college graduates to be greater participants in cost-share programs. Gould, Saupe, and Klemme, and Rahelizatovo and Gillespie found more highly educated producers to be greater BMP adopters.

Independent Variables—The Role of Land Resource and Information

This section discusses variables that consider land resource and information considerations of the farm, l and i, respectively in Equations (1)–(3). Postapplication for EQIP in Louisiana, an evaluation form is used to determine whether or not the project will be funded. It is expected that producers with a resource concern who would score more favorably in receiving EQIP funds would more likely be made aware of EQIP by official (e.g., NRCS or the LSU AgCenter) and unofficial (e.g., other producers) sources and, hence, they would apply. Evaluation criteria in 2002 dealt mainly with whether major environmental concerns were met, a few of which would include reducing water erosion, reducing tillage operations, utilizing waste, and developing a conservation plan.

Two variables are included as land descriptors. The first is whether a stream or river runs through the farm, *STREAM*, and the second is whether the farmland has been classified as "highly erodible," *ERODIBLE*, by the NRCS. The presence of a stream or river or highly erodible land would generally cause a producer to have a greater chance of being selected for the EQIP, since a resource concern would be addressed. If these producers are more likely to be made aware of the EQIP whether via various organizations or other producers, and hence encouraged to apply for the EQIP, then *STREAM* and *ERODIBLE* would be expected to increase awareness of and application to the EQIP. Lambert et al. found that producers with highly erodible land were greater participants in partial farmland retirement. Rahelizatovo and Gillespie, and Soule, Tegene, and Weibe found dairy producers and corn producers, respectively, of highly erodible land to be greater BMP adopters. Other land descriptors have also been found to influence BMP adoption (Lichtenberg; Wu et al.).

Two variables are included to examine the role of information on awareness of and application to the EQIP. Variables *NRCS* and *LCES* indicate that the producer had business contact with the respective agencies' personnel during the previous year. The Master Farmer Program is administered by the Louisiana Cooperative Extension Service (LCES) with a major emphasis on the adoption of BMPs. Thus, greater contact with LCES would be expected to increase awareness of and application to the EQIP. Both *NRCS* and *LCES* were tested for endogeneity using the Durbin–Wu–Hausman test, as discussed in Bollen, Guilkey, and Mroz.

Results

Of the 489 respondents who responded to the question regarding whether they were aware that they could apply for EQIP funds when implementing conservation practices, 51% responded affirmatively. Of those who were

aware, 55% had applied for EQIP funding. These percentages, when weighted to the population according to the stratified sample, are 44% and 51%, respectively, suggesting that just under half of the cattle producers had heard of the EQIP and about half of those who had heard of it had applied for funds.

The Park test (Hill, Griffiths, and Judge) was used to test the models for heteroskedasticity. For all runs, results showed p-values greater than 0.10, indicating that heteroskedasticity was not detected. Correlation coefficients, variance inflation factors, and the Collins test (Kennedy) did not reveal evidence of serious multicollinearity.

Negative Binomial Regression for the Instrumental Variable Run

Several variables, *NRCS*, *LCES*, and *NUMBMPS*, were tested for endogeneity. Though endogeneity was not found using the Durbin–Wu–Hausman test for any of the three variables, results of the *NUMBMPS* run were of particular interest, so they are reported in the paper. The explanatory variables used in the negative binomial regression run were *FARMACRES*, *OFFFARM*, *%INCBEEF*, *DIVERSE*, *LOWNED*, *STREAM*, *ERODIBLE*, *NRCS*, *LCES*, *AGE*, *COLLEGE*, *DEBT* (farmer's debt–asset ratio, measured in 20% intervals from 0–20% to ≥60%), and *CONTINUE* (the number of years the farmer expected to continue in beef production). Descriptive statistics for each are found in Table 1.

Variables that were significant in the *NUMBMPS* run included *%INCBEEF*, *DIVERSE*, *LOWNED*, *LCES*, *COLLEGE*, *CONTINUE*, and *DEBT* (Table 2). These results suggest that producers who had greater percentages of household net income from the beef operation, were more diversified, owned greater proportions of their farmland, had met more extensively with LCES personnel, held a 4-year college degree, had higher debt-to-asset ratios, or planned to continue in beef production longer were more likely to have adopted a greater number of BMPs at their own expense. Results of a negative binomial run on BMP adoption by Louisiana dairy producers (Rahelizatovo and Gillespie) showed generally consistent results, though their results showed that dairy producers who owned greater proportions of their land were lower BMP adopters, in contrast with present study results. Present study results are expected if landowners are the principal beneficiaries of BMPs.

Awareness of and Application to the EQIP as Individual Runs

Significant independent variables in the individual probit runs for the awareness of and application to the EQIP are shown in Tables 3 and 4, respectively. Observations were deleted if there were missing data for any of the variables used in the analysis.

Producers who were more likely to be aware of the EQIP farmed more land, had adopted a greater number of BMPs at their own expense, earned less total household income, farmed land that had been classified as "highly erodible," and had contact with NRCS or LCES personnel (or both) in the past year. An additional 100 acres of farmed land increased the probability of awareness of the EQIP by 0.0124. Each additional BMP adopted at the producer's own expense increased the probability of awareness of the EQIP by 0.0208. Having household income of at least $90,000 decreased the probability of awareness of the EQIP by 0.1338. Farming highly erodible land increased the probability of awareness of the EQIP by 0.3120. Having had contact with NRCS or LCES in the past year increased the probability of awareness of the EQIP by 0.3979 and 0.1645, respectively.

These results highlight the influence of farm size, previous BMP adoption, income, and land type as management and financial considerations in program awareness, as well as the important role of information distribution by agencies such as NRCS and LCES. Of note is that higher-income producers were less likely to be aware of EQIP, a result that conflicts with McLean-Meyinsse, Hui, and Joseph's results with limited-resource producers. These results, however, lead to the

Table 1. Definitions and Descriptive Statistics of Independent (Explanatory) Variables, $n = 481$

Variable	Units	Definition	Mean	Std.	Min	Max
FARMACRES	Acres/100	Total acres of land used in the cattle operation, divided by 100	3.77	7.87	0.01	120.00
%INCBEEF	0–5	Percentage of net household income from beef production: 1: 0–20%; 2: 21–40%; 3: 41–60%; 4: 61–80%; 5: 81–100%	1.32	0.79	1.00	5.00
OFFFARM	0–1	Whether more than half of household income is from off-farm sources: 1: Yes; 0: No	0.66	0.47	0.00	1.00
DIVERSE	Number	Number of enterprises other than beef on the farm	1.03	1.07	0.00	7.00
NUMBMPS	Number	Number of BMPs practiced by the farmer at own expense	6.61	3.95	0.00	16.00
LOWNED	Ratio	Ratio of land owned to total land operated by the farmer	0.68	0.37	0.00	1.00
HIGHINC	0–1	Household income: 0: <$90,000, 1: ≥$90,000	0.19	0.39	0.00	1.00
STREAM	0–1	1: A stream or river runs through the farm; 0: otherwise	0.42	0.49	0.00	1.00
ERODIBLE	0–1	1: Land has been declared "highly erodible"; 0: otherwise	0.06	0.24	0.00	1.00
NRCS	0–1	1: Farmer met with NRCS personnel ≥1 time in past year; 0: otherwise	0.35	0.48	0.00	1.00
LCES	0–1	1: Farmer met with LCES personnel ≥1 time in past year; 0: otherwise	0.54	0.50	0.00	1.00
AGE	Years/10	Age of the farmer, divided by 10	5.86	1.25	2.30	8.70
COLLEGE	0–1	Level of farmer's education: 1: 4-year college degree or higher; 0: no 4-year college degree	0.30	0.46	0.00	1.00
CONTINUE	Years	Number of years a farmer plans to continue operating the beef cattle operation	15.06	10.82	0.00	50.00
DEBT	0–4	Debt-to-asset ratio: 0: 0–20%; 1: 21–40%; 2: 41–60%; 3: ≥60%	0.24	0.66	0.00	3.00

question of whether higher-income cattle producers have as much incentive to inform themselves of government incentive programs, holding farm size and off-farm income sources constant.

Producers who were more likely to have applied for EQIP funds (the subset of those who were aware of the EQIP) were less likely to have received >50% of their income from off-farm sources, were less likely to have received lower percentages of their household incomes from the beef operation, were less likely to have streams running through their property but more likely to farm highly erodible land, had contact with NRCS in the previous year, or did not hold 4-year college degrees. Having >50% of income from off-farm sources reduced the probability of application for EQIP funds by 0.1895. Increasing the percentage of income from beef by 20% reduced the probability of application for EQIP funds by 0.1538. Having a stream running through the property reduced the probability of application for EQIP funds by 0.1665, but farming land that was classified as highly erodible increased the probability of application for EQIP funds by 0.2145. Having had NRCS contact in the past year increased

Table 2. Negative Binomial Estimates: Number of BMPs Practiced by Farmers at Their Own Expense (*NUMBMPS*)

Variable	B	Standard Error
Constant	1.0510**	0.2585
FARMACRES	0.0000	0.0036
OFFFARM	0.1075	0.0686
%INCBEEF	0.0930**	0.0389
DIVERSE	0.0655**	0.0259
LOWNED	0.1816**	0.0866
STREAM	0.0750	0.0613
ERODIBLE	0.1433	0.1078
NRCS	0.0987	0.0657
LCES	0.1685**	0.0654
AGE	0.0169	0.0360
COLLEGE	0.1220*	0.0642
CONTINUE	0.0083**	0.0036
DEBT	0.0966**	0.0485

Note: ** and * indicate significance at the 0.05 and 0.10 levels, respectively.

the probability of application for EQIP funds by 0.4511. Holding a 4-year college degree decreased the probability of application for EQIP funds by 0.1371.

The result that those who received lower percentages of income from the beef operation were greater applicants to EQIP is plausible, especially if the other farm income was derived from alternative enterprises on the farm that were traditional government program enterprises or enterprises that have been more specifically targeted in water-quality concerns, such as AFOs or CAFOs. Two surprising results were that producers with streams running through their land were less likely to have applied, as were college graduates.

Table 3. Probit Estimates of Farmer Awareness of EQIP, $n = 444$

Variable	Marginal Effect	Standard Error
Constant	−0.5519**	0.1524
FARMACRES	0.0124**	0.0062
OFFFARM	−0.0403	0.0584
%INCBEEF	−0.0162	0.0456
DIVERSE	0.0250	0.0275
NUMBMPS	0.0208**	0.0074
LOWNED	0.0451	0.0761
HIGHINC	−0.1338*	0.0699
STREAM	−0.0089	0.0548
ERODIBLE	0.3120**	0.1065
NRCS	0.3979**	0.0527
LCES	0.1645**	0.0543
AGE	0.0234	0.0222
COLLEGE	−0.0042	0.0634

Notes: McFadden R^2: 0.1938; % correctly predicted: 71.85%. ** and * indicate significance at the 0.05 and 0.10 levels, respectively.

Table 4. Probit Estimates of Farmer Application for EQIP Funds, $n = 224$

Variable	Marginal Effect	Standard Error
Constant	0.0875	0.2259
FARMACRES	0.0043	0.0042
OFFFARM	−0.1895**	0.0762
%INCBEEF	−0.1538**	0.0574
DIVERSE	0.0023	0.0363
NUMBMPS	−0.0080	0.0104
LOWNED	−0.0986	0.1083
HIGHINC	−0.0880	0.0998
STREAM	−0.1665**	0.0743
ERODIBLE	0.2145*	0.1128
NRCS	0.4511**	0.0724
LCES	0.0002	0.0847
AGE	0.0442	0.0342
COLLEGE	−0.1371*	0.0812

Notes: McFadden R^2: 0.1486; % correctly predicted: 69.20%. ** and * indicate significance at the 0.05 and 0.10 levels, respectively.

Probability of Farmers Being Aware of and Applying to the EQIP: Bivariate Probit

Bivariate probit with partial observability results provide greater insight into the producers' likelihood of awareness and application to the EQIP. The value of ρ in this regression is −0.9996, with significance at the 0.01 level, indicating correlation of the disturbances after the included variables are considered. Variables affecting the probability of a producer being aware of and having applied were *OFFFARM*, *NUMBMPS*, *INCOME*, *ERODIBLE*, *NRCS*, *LCES*, and *AGE* (Table 5). Having >50% of household income from off-farm sources reduced the probability of awareness of and application for the EQIP by 0.1218. Having adopted an additional BMP at one's own expense increased the probability of awareness of and application

Table 5. Bivariate Probit with Partial Observability Estimates of Marginal Effects: Marginal Probability of Farmers Having Knowledge of EQIP and Applying to the Program, $n = 444$

Variable	Marginal Effect	Standard Error
FARMACRES	0.0198**	0.0054
OFFFARM	−0.1218*	0.0635
%INCBEEF	−0.0955	0.0597
DIVERSE	−0.0008	0.0308
NUMBMPS	0.0170**	0.0077
LOWNED	0.0796	0.0832
INCOME	−0.2041**	0.0800
STREAM	−0.0724	0.0586
ERODIBLE	0.3551**	0.1456
NRCS	0.5348**	0.0608
LCES	0.1270**	0.0609
AGE	0.0401*	0.0233
COLLEGE	0.0244	0.0608

Note: ** and * indicate significance at the 0.05 and 0.10 levels, respectively.

for the EQIP by 0.0170. Having household net income of at least $90,000 decreased the probability of awareness of and application for the EQIP by 0.2041. Farming land classified as highly erodible increased the probability of awareness of and application for the EQIP by 0.3551. Having had NRCS or LCES contact over the past year increased awareness of and application for the EQIP by 0.5348 and 0.1270, respectively. Finally, each additional 10 years of age increased the probability of and application for the EQIP by 0.0401.

Previous BMP adopters who had adopted at their own expense were more likely to be aware of and to have applied for EQIP funds, suggesting that EQIP is attracting producers with a previously developed interest in BMPs. Producers with relatively lower household incomes were more likely to be aware of and to have applied for EQIP, suggesting that the program is being utilized by the producers who have the greatest financial need. Related to this, however, is that those with significant off-farm income were less likely to be aware of and to have applied for EQIP. As expected, those with highly erodible land and who had been in greater contact with NRCS and LCES were more aware of EQIP and more likely to have applied. The *AGE* result is consistent with results of McLean-Meyinsse, Hui, and Joseph, and Onianwa et al., who found, among limited-resource farmers, older producers to be the greater participants in the CRP and cost-share programs, respectively.

Conclusions

This study provides a view of the types of cattle producers who are likely to have the greatest awareness of and to be the most extensive applicants to government programs, specifically the EQIP. Because many cow–calf producers are relatively small, part-time, or retired; cattle operations have had few government programs specifically targeted to them; cow–calf operators are likely to be motivated by a variety of goals, only one of which is profit; and few if any cow–calf operations would be considered a CAFO or AFO; one might initially expect cattle producers to be less aware of new conservation programs than producers of other crops or livestock. Results of this study suggest that, at the time of this survey, just under half of the producers were aware of the EQIP, and of those who were aware, about half had applied for funds. This survey was conducted in 2003, 7 years after the EQIP was originally established (1996), and 1 year after it was designated that the majority (≥60%) of EQIP funds would be used to address livestock concerns (2002). Given these parameters, we consider these results to indicate a relatively low level of cattle producer awareness of government programs that could benefit them.

This study suggests that management, financial, land resource, and information factors as discussed in the conceptual model section and expanded in the methods section have influenced producers' awareness of and application for the EQIP. Previous BMP adopters at their own expense had greater awareness of and were the greater participants in the EQIP. Although this result is not surprising, it suggests that many farmers with perhaps less interest in BMP adoption are not receiving information that this program exists

or are not applying. Given that the lower applicants have adopted fewer BMPs at their own expense, holding land quality constant (with variables *STREAM* and *ERODIBLE*), this implies that applicants are the individuals who have a greater interest in BMPs in general.

The impact of education on previous BMP adoption at own expense and awareness of the EQIP provided mixed results that deserve further consideration. On the one hand, it was found that those with college degrees had adopted BMPs at their own expense more extensively than had their peers who did not hold college degrees. This result is largely consistent with other studies that have found educated producers to be the greater adopters of technology. *COLLEGE* was not significant in the individual probit awareness run, but a significant negative sign was found on the application run. The overall result is plausible if more educated producers have greater awareness of the benefits of BMPs and have thus already adopted, while less educated producers are less aware of the benefits and need further economic incentives to entice adoption. We suggest that future studies dealing with BMP adoption further investigate this to determine whether the result holds over a wider geographical region or among other enterprises.

Producers who are aware of and are the greater applicants to the EQIP can further be described as having lower percentages of income from off-farm sources, lower net household income, farming highly erodible land, and having contact with NRCS and LCES. Though previous studies have found higher-income producers to be the greater BMP adopters, it can be argued that government payments should go to those with greater need, including lower-income producers with land that is highly susceptible to erosion. Those having higher off-farm incomes are likely to have greater opportunity costs associated with learning about agricultural programs relative to the associated benefits. We suggest, however, that the reasons be further investigated.

What is clear from this sample of producers is that the less-informed producers who are making less use of the program are generally smaller, part-time farmers with relatively high incomes who tend to seek less advice from agencies that provide farming information, such as NRCS and LCES—and they are the lower adopters of BMPs in general. The beef industry likely has a disproportionately high number of producers of this demographic status, as its relatively low use of assets specific to beef and relatively low labor requirement per acre lends itself more readily to part-time farming than some other enterprises, such as dairy. Targeting educational programs on BMPs and EQIP to the small, younger, part-time cattle producer is likely to create significant challenges as these producers' opportunity costs associated with training programs are likely to be relatively high.

We suggest several areas of future research on this subject: (1) Among CAFOs and AFOs, how aware of and how extensively have producers applied to the EQIP? (2) What are the most effective information dissemination methods for getting information about environmental programs to producers? Finally, (3) once producers are aware of programs such as the EQIP, what level of cost-share or incentive payment will entice them to apply?

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