Awareness of the Environmental Quality Incentives Program and subsequent adoption of best management practices by cattle farmers in Louisiana

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AWARENESS OF THE ENVIRONMENTAL QUALITY INCENTIVES PROGRAM AND SUBSEQUENT ADOPTION OF BEST MANAGEMENT PRACTICES BY CATTLE FARMERS IN LOUISIANA

A Thesis
Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
In Partial Fulfillment of the
Requirements for the
Master of Science

In

The Department of Agricultural Economics
and Agribusiness

by

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ABSTRACT

In recent years, the US livestock industries have undergone structural changes that have led to larger livestock operations with their associated environmental problems. Louisiana is within one of the major cow-calf production areas in the US (the Southeast). Louisiana accounts for about 1.72% of the total US cattle operations. In an attempt to control degradation of the environment, conservation programs have been put in place, one of which is the Environmental Quality Incentives Program (EQIP). The EQIP was established in the 1996 Farm Bill, involving the payment of government subsidies to landowners willing to implement specific cost-intensive conservation practices. The aim of this study is to determine, using a sequential response model, the awareness of EQIP and subsequent adoption of best management practices (BMPs) by cattle farmers in Louisiana. Results indicate that of the 504 cattle farmers who completed the survey questionnaire, the probability of a farmer having no knowledge of EQIP (EQIP\textsubscript{0}) is 0.481; the probability of a farmer having knowledge of EQIP but not applying to the program (EQIP\textsubscript{1}) is 0.298; the probability of a farmer having knowledge of EQIP, applying to the program, but not receiving payment (EQIP\textsubscript{2}) is 0.152; the probability of a farmer having knowledge of EQIP, applying to the program, receiving payment, and not canceling the program later (EQIP\textsubscript{3}) is 0.003; and the probability of a farmer having knowledge of EQIP, applying to the program, receiving payment, and canceling the program later (EQIP\textsubscript{4}) is 0.066. Variables used in the analysis that influenced the awareness of EQIP and the subsequent adoption of BMPs were the number of times a farmer met with NRCS and/or extension agents in the year 2002, whether the farmer’s
land had been declared “highly erodible” by NRCS, whether a stream flowed through or close to the farm, whether the farmer was diversified, the size of the cattle operation, and the percentage of household income coming from beef production.
CHAPTER 1
INTRODUCTION

In recent years, the US livestock industries have undergone structural changes involving technological innovations, changes in production systems and specialization (Brubaker). These changes have led to larger and concentrated livestock operations with their related environmental problems. Louisiana accounts for about 1.72% of the total US cattle operations. It faces environmental problems related to disposal of animal waste and application of agrochemicals. In an attempt to control degradation of the environment by the agricultural sector, some conservation programs have been put in place. One such program is the Environmental Quality Incentives Program (EQIP). The EQIP is a program established in the 1996 Farm Bill and reauthorized in the 2002 Farm Bill. This program involves the payment of government subsidies to landowners willing to implement specific cost-intensive conservation practices. The payments under this program are of two types: (1) cost-sharing, which applies to structural and vegetative practices and covers a maximum of 90% of the cost of implementation for limited resource or beginning producers and 75% for others, and/or (2) an incentive payment that is made to producers to encourage them to adopt land management practices they may not otherwise have adopted. The EQIP offers five to ten year contracts. Total cost–share and incentive payments are limited to $10,000 per person per year or $50,000 over the length of the contract (Vigil et al.).

The EQIP works together with other federal conservation programs that generate environmental benefits. Some of these programs include the Conservation Reserve Program, the Wetlands Reserve Program, and the Wildlife Habitat Incentives Program. The EQIP is the only USDA conservation program that contains an explicit clause targeting funds to address environmental concerns arising from livestock production. Nationally, at least 50% of EQIP funds must be used for natural resource concerns related to livestock.
Over the years of its term, the 2002 Farm Bill significantly increases EQIP funding. In 2002, funding was at $400 million; in 2003, it increased to $700 million; and by 2004, it rose to $1 billion per year (Vigil et al.). An increase in the cost of production associated with adoption of conservation practices could be partially compensated by funds from the EQIP program. The Bill also removed the limit on the eligibility for larger operators to receive cost-share funds for animal waste management facilities. This was to enable larger operators to comply with new Environmental Protection Agency rules. The question now is, are most farmers aware of the EQIP program, and if so, how many of them have applied for EQIP funding and subsequently adopted best management practices (BMPs) with the funding?

The aim of this study is to determine the portions of cattle farmers in Louisiana who (1) are aware of the EQIP program, (2) have subsequently applied for EQIP funds, and (3) have subsequently adopted BMPs. The types of producers most likely to have heard of the program, applied for funds, and subsequently adopted are also determined.

1.1 PROBLEM STATEMENT

The ignorance of EQIP by cattle operators that subsequently prevents them from implementing BMPs might be related to social isolation. In 1951, Wilkening defined social isolation as a lack of or a decrease in meaningful social contacts with other persons. It was identified as a problem that affected the response of farmers to agricultural programs. It was observed that social isolation was associated with lack of effective contact with neighbors or participation in programs for one’s own benefit. Lack of knowledge of programs may lead to a defense mechanism such as attacks on those who run the programs or the tendency to resist the acceptance of new ideas due to insecurity. It was also observed that those who had moved to their present locations from other communities had not adopted improved farm practices
recommended by agricultural programs. Other factors also associated with social isolation are political party affiliations, death of a spouse, personality characteristics, and physical isolation.

Producers’ lack of information about the profitability and the environmental benefits of adopting BMPs may be one of the problems affecting the control of agricultural nonpoint source of pollution (DeVuvst and Ipe; Feather and Amacher). This may be particularly so in industries where a relatively small percentage of the person’s income is derived from that industry, such as with cattle.

It has been observed that using public-supported financial incentives offered by EQIP to aid farmers in the adoption of BMPs is effective. However, current use of EQIP for this purpose has been described as “modest to meager” (Brewer et al.). Thus, there is a need to increase farmers’ awareness of the program.

Table 1 displays the number of cattle operations in Louisiana from 1993 to 2004. Large-scale cattle operators, classified as those who own 500 or more head of cattle and calves, represented 1.03% to 1.38% of the cattle operations in years 1993 and 2004, respectively. Small-scale farmers, classified as farmers who own 1 to 99 head of cattle and calves, represented 86.67% to 84.83% of the operations in the years 1993 and 2004, respectively. This information shows that small-scale cattle operations represent the largest portion of Louisiana’s cattle operations. From year 1996, when the EQIP was first established, to 2004, the number of small-scale cattle operations has generally declined while large-scale operations have remained fairly constant in number. However, in general, the number of cattle operations has been declining (Figure 1). The decline in the number of cattle operations suggests that farmers are going out of business as they are not able to meet the rising costs of production. Some of the rising costs may be attributed to mandatory conservation practices. Since the environmentally harmful effects of
some agricultural practices, e.g., manure spreading, related to livestock production cannot be directly regulated, indirect policies such as direct taxes on livestock operations, scale regulations that limit the number of animals on a given number of acres, and waste storage and handling regulations may be used.

TABLE 1: NUMBERS OF CATTLE OPERATIONS IN LOUISIANA, BY SIZE

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Number</th>
<th>1-49 Head Number</th>
<th>50-99 Head Number</th>
<th>100-499 Head Number</th>
<th>500-999 Head Number</th>
<th>1000+ Head Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>19500</td>
<td>14100</td>
<td>2800</td>
<td>2400</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>1994</td>
<td>18300</td>
<td>13000</td>
<td>2800</td>
<td>2300</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>1995</td>
<td>16800</td>
<td>11600</td>
<td>2800</td>
<td>2200</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>1996</td>
<td>16600</td>
<td>11000</td>
<td>2800</td>
<td>2560</td>
<td>190</td>
<td>50</td>
</tr>
<tr>
<td>1997</td>
<td>16500</td>
<td>11300</td>
<td>2600</td>
<td>2350</td>
<td>210</td>
<td>40</td>
</tr>
<tr>
<td>1998</td>
<td>15500</td>
<td>10700</td>
<td>2300</td>
<td>2300</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>1999</td>
<td>15500</td>
<td>11400</td>
<td>2000</td>
<td>1900</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>2000</td>
<td>15500</td>
<td>11200</td>
<td>2100</td>
<td>2000</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>2001</td>
<td>15000</td>
<td>10800</td>
<td>2000</td>
<td>2000</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>2002</td>
<td>15000</td>
<td>11000</td>
<td>1800</td>
<td>2000</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>2003</td>
<td>15000</td>
<td>11000</td>
<td>1800</td>
<td>2000</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>2004</td>
<td>14500</td>
<td>10500</td>
<td>1800</td>
<td>2000</td>
<td>160</td>
<td>40</td>
</tr>
</tbody>
</table>

Data source: www.nass.gov

In order for cattle farmers to obtain permits from the Environmental Protection Agency to discharge into surface waters, the farmers’ facilities must include waste handling systems that hold the animal waste (Innes). These policies may be among a number of factors that have caused the number of livestock producers to decrease from 1997 to 2000 by 72% nationwide. The Louisiana situation is illustrated graphically in Figure 2. Farmers who cannot handle the cost of taxes and the implementation of BMPs stated in these policies sell their farmland (Nickerson and Lynch). EQIP, however is an alternative option farmers can use if they are aware of its
existence. Oates et al. indicated that decentralized incentive-based policies such as the EQIP are more effective than centralized command-and-control and are less costly to society.

Another problem related to cattle operations is the large amount of manure produced that eventually may cause air and water pollution. Industrial man’s technology generally increases productivity. However, when this technology is used continuously over an extended period of time, environmental problems may result (Brubaker). An example is seen in the study carried out by Kaplan et al. Modern feedlot cattle production involves confining large numbers of animals in a small area and close to urban areas.

![Graph showing numbers of cattle and calf operations in Louisiana from 1970 to 2004.](image)

**FIGURE 1**
**NUMBERS OF CATTLE AND CALF OPERATIONS IN LOUISIANA, 1970 TO 2004**

Data source: www.nass.gov
This practice also involves the use of large quantities of water and feed and produces large amounts of waste. The large volume of waste when applied to the land for an extended period of time leaches off or runs off into water bodies, thus contributing to pollution. Farmers attempting to reduce pollution may either reduce output or use alternative waste disposal practices. This, in turn, imposes costs on the agricultural community as well as affects commodity prices (Morrison-Paul et al.).

1.2 OBJECTIVES OF THE STUDY

The objectives of this study are to: (1) determine the proportions of cattle producers in Louisiana who: (a) have 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 and been accepted, but cancelled
the contract later; and (2) determine the types of producers who fall into each of these categories.

1.3 JUSTIFICATION

Environmental degradation by agricultural and non-agricultural activities has become a
major problem facing society today. Some studies have shown that the adoption and
implementation of BMPs help reduce pollution at little cost to the farmer. Adoption of the
practices is said to be more effective if public supported financial incentives are offered to
farmers through programs like EQIP (Brewer et al.; DeVuvst and Ipe).

Studies also indicate that, compared to direct regulations or financial incentives, increasing
farmer’s knowledge might be a more cost-effective method of increasing the adoption of BMPs
(Feather and Amacher; Feinerman et al.). Personnel involved in the administration of the EQIP
are in contact with farmers and thus play an important role in educating farmers on BMPs.
Farmers’ perceptions are changed in the process, increasing their knowledge of BMPs and of
conservation programs. This then encourages farmers to adopt BMPs to deal with environmental
problems related to their agricultural activities with little welfare loss and at reduced costs
(Taylor et al.).

Studies suggest that, with economic incentives, farmers are more likely to adopt BMPs
(DeVuvst and Ipe). The EQIP compensates farmers while minimizing the likelihood of farmers
not implementing BMPs. The EQIP serves as a vessel through which policies are advanced to
address environmental problems. Studies have shown that federal and state incentives, mandates
and support programs, including research and development have been effective in advancing
policies that address environmental problems (Gielecki et al.; Bouamra-Mechemache et al.).
In summary, it is important that farmers are made aware of the EQIP because it is intended to give them the incentive to implement BMPs that are environmentally friendly and it educates farmers on BMPs that improve efficiency.
Previous work carried out on the awareness and adoption of conservation programs and BMPs by farmers forms the basis of the literature to be reviewed for this study.

2.1 THE IMPORTANCE OF BMPS

Sustainable agricultural development is seen as a critical part of the strategy to overcome environmental degradation as well as poverty. Prompted by this, Antle and Diagana assessed the role soil carbon sequestration plays in helping developing countries deal with soil degradation problems, if governmental or nongovernmental entities take actions to reduce greenhouse gas emissions. Factors affecting incentives for soil conservation were established property rights to land and the general policy environment. The results obtained from this research suggest that emerging policies such as those that would mitigate greenhouse gases could provide a way to create incentives for farmers to adopt and maintain practices that would have long-term benefits in reducing net greenhouse gas emissions.

Brannan et al. conducted a study on the beneficial impacts of animal waste BMPs on surface water quality over a ten-year period. The parameters measured were precipitation, stream flow, total suspended solids, nitrogen and phosphorus. The main objective of the study involved determining the effectiveness of a system of animal waste BMPs. Results indicated that the BMPs were effective in reducing nutrient loadings, especially concentrations of all forms of nitrogen with the highest reduction percentage of 62% and a minimum of 35%. However, for phosphorus, the highest reduction was for particulate phosphorus.

Motivated by increasing concerns about bacteria pollution, Inamdar et al. carried out a study on the impact of animal waste BMPs on indicator bacteria concentrations. The objective of the study was to evaluate the effectiveness of BMPs in reducing bacterial pollution in a
watershed over a ten-year period. The bacteria fecal coliforms and fecal streptococci were measured as pollution indicators. The BMPs implemented included manure storage facilities, stream fencing, water trough and nutrient management. Results showed significant decreases in bacteria concentrations at the watershed outlets. The study, however, suggested that BMP implementation alone might not ensure compliance with current water quality standards.

Edwards et al. examined the effect of BMP implementation on storm flow quality on streams in Arkansas over three years. The objective of the study was to determine how effective BMP implementation would be on reducing storm stream-flow concentrations on nitrogen and its compounds, phosphorus and suspended solids. Results indicated significant decreases within the range of 25% to 75% a year, mainly in nitrogen compounds. The BMP responsible for the decrease was identified as nutrient management.

Epp and Hamlett evaluated the cost effectiveness of seven conservation BMPs and two nutrient management programs for three sites of a river basin in Pennsylvania. The parameters measured included BMP implementation costs, field operation rests, and farm revenue. The present values of the net field revenue over ten years for each of the BMPs were compared to that of the baseline for cost effectiveness in reducing sediment and other nutrient losses. Results indicated that nonstructural BMPs resulted in less reduction in net farm income (and in some instances, increased net farm income) than did structural BMPs. When combined with nutrient management programs, nonstructural BMPs resulted in higher net farm incomes.

Sun et al. examined expected returns and the environmental effects of implementing BMPs under risky or uncertain conditions. Results indicated that controlling agricultural nonpoint source pollution through BMPs alone could be very expensive. It was suggested that
federal cost-share programs designed to provide incentives to farmers to adopt economically efficient and environmentally friendly BMPs could make the control of pollution more feasible.

2.2 ADOPTION: DEFINITION AND FACTORS AFFECTING IT

Feder et al. defined an adoption process as “the mental process an individual passes from first hearing about an innovation to finally adopting it”. Adopting technology may offer an opportunity to increase production and income. However, factors such as a lack of credit, limited access to information, aversion to risk, inadequate farm size, inadequate incentives, insufficient human capital, absences of equipment to relieve labor shortages, and others, hold back the rapid adoption of these innovations (Feder et al.). Programs have sought to remove some of these hindrances. It was expected that providing needs via programs would not only result in adoption but also improve practices. However, it has been observed that the adoption behavior of farmers differs over time and across socioeconomic groups (Feder et al.).

Technology, in many cases, is introduced in packages that include several components. While components of a package may complement one other, some of them may be adopted independently. Whether technology is used more or less intensively may partially depend on whether it decreases or increases risk. The adoption rate of a package is retarded if there is a binding constraint. As such, policies, which enhance the adoption of one component, may retard the adoption of the others (Feder et al.).

Feder et al. observed that the likelihood of adopting technology increases as the information pertaining to the technology, the producer’s skills and income increase. They also discussed the role of the physical environment of the farm in technology adoption. It was observed that farms smaller than a critical level would not adopt new technology, and the critical
size increased with higher fixed information costs. Following are studies recently conducted that deal with the adoption of conservation technologies.

Khanna analyzed the sequential decision to adopt two site-specific technologies, soil testing and variable rate technology (VRT), and determined the impact of adoption on nitrogen productivity and corn yield. Variables used in the analysis included proxies for scale economies, human capital, innovations, land ownership, relative soil quality, cost of adoption and farm location. Results showed that farm location was a key variable influencing adoption of soil testing. Farm size, human capital and innovativeness of farmers had significant effects on adoption of VRT. It was also observed that for farms with below-average soil quality, adoption led to significant gains in nitrogen productivity. In above-average soil quality farms, adoption led to insignificant gains.

Habron examined the adoption of conservation practices by agricultural landowners in three watersheds in southwestern Oregon with the objectives to determine the characteristics of adopting and non-adopting landowners. Results indicated that landowners who used irrigation, shared management decisions with a spouse, believed in scientific experimentation, and discussed conservation with others were more likely to have adopted conservation practices. It was also observed that landowners implemented upland conservation practices such as off-stream livestock water development and rotational grazing more than non-landowners. The study indicated that the adoption of BMPs depended mainly on the kind of BMPs to be implemented.

Rahelizatovo and Gillespie examined factors influencing the implementation of BMPs in the dairy industry. Results showed that factors such as farm characteristics, institutions related to the dairy operation and producer attitudes influenced adoption. The study also suggested the need to address the lack of knowledge of BMPs among dairy farmers.
Onianwa et al. examined the factors affecting participation behavior of limited resource farmers in cost-share programs in Alabama using a binary logit model. Results indicated that college education, age, total farm size and being a member of a conservation association significantly influenced participation in cost-share programs.

Kim et al. examined factors affecting cattle producers’ adoption of BMPs. Results indicated that diversified farmers, farmers who had contact with NRCS personnel at least once a year, farmers level of education, the percentage of income from beef production, and whether the farmer operated on hilly land were the main determinants of BMP adoption.

Doyle and Johnson studied the complexity of increasing water use efficiency, a BMP on irrigated dairy farms. They observed that measuring and improving efficiency of water use is complex, due to certain constraints, one of which is the lack of sound technical information. The study suggested that the efficiency sought might not be realized if government, industry and others involved in natural resource management did not implement appropriate policy instruments to encourage adoption of BMPs.

Ersado et al. examined the interactions between public investments, community health, and the adoption of productivity and land enhancing technologies by households in the northern Ethiopian state of Tigray. Results indicated that time spent sick and the opportunity cost of caring for the sick are factors in adoption, significantly reducing the likelihood of technology adoption. Their findings also suggest that agencies working to improve agricultural productivity and land resource conservation should consider not only the financial status of potential adopters, but also their health situation.
2.3 INCENTIVE PROGRAMS: AWARENESS AND BENEFITS

Feather and Amacher examined the role of information in the adoption of BMPs for water quality improvement. They observed that a lack of producer information regarding the profitability and environmental benefits of adopting may explain why their adoption has not occurred extensively. It was also observed that, compared to direct regulation or financial incentives, raising producers information levels may be a more cost-effective method of increasing adoption. Also, producer perception plays an important role in the decision to adopt; thus, education may be a means of changing these perceptions and encouraging the adoption of BMPs.

Ipe et al. defined incentive programs as guarantees that farmers adopting BMPs earn at least the same level of profit, on average, as those who do not adopt them. They examined the environmental impact of the reduction in annual emissions of nitrates and the impact of incentive programs on the concentration of nitrates in lake water. Results indicate that as nitrogen application rate was reduced, emissions declined at a decreasing rate. Comparing expected payment and annual reduction in emissions under different scenarios, $0.34 per acre would reduce nitrogen emission 34% and $1.40 per acre would reduce emission by 40%. For scenarios where the payment was zero, the percentages were less. The study also suggested that implementing BMPs might not necessarily reduce farm profits but, on the contrary, may increase farm profits and reduce environmental pollution. It was also suggested that incentive programs be implemented as an educational effort to demonstrate the benefits of sound management practices.

Cooper examined farmers’ decisions to accept incentive payments in return for adopting a bundle (ten) of management practices using EQIP-type programs. Results indicated a producer’s
tendency to bundle types of management practices that may be covered under an incentive payment, thus increasing the adoption of these types of practices and lowering the cost of voluntary adoption programs.

DeVuyst and Ipe examined a group incentive contract as a source to promote the adoption of BMPs. The study was conducted because BMPs are sometimes perceived by farmers as having economic disadvantages. They indicated that it might be necessary to provide economic incentives to encourage farmers to adopt BMPs in environmentally sensitive watersheds. The group incentive contract is aimed at compensating farmers for actual damages due to BMP adoption while avoiding moral hazard problems. The study showed that, upon adoption of BMPs, the majority of nitrogen pollution generated in Illinois could be eliminated at little or no cost.

Brewer et al. examined the opportunity for public-supported financial incentives to implement integrated pest management. They observed that the new management techniques often result in higher financial burden to the grower. In order for Integrated Pest Management to be adopted, they found a need to deliver public-supported financial incentives to farmers. The study explored opportunities and challenges associated with using EQIP. It was observed that 25% of the farmers surveyed recognized the program’s use as a way of introducing and implementing the management technique. For 75% of the farmers, implementation of the management practice was improved after educational efforts by the NRCS advisory process under the EQIP program. The study further suggested that the case is strong for using public-supported financial incentives as a means to aid farmers in adoption, particularly through EQIP. It was observed that the use of EQIP for getting farmers to adopt BMPs is modest to meager.
Gauthier et al. studied the influence of cost share and EQIP incentive payments on the adoption of 18 BMPs by Louisiana dairy farmers. Results indicated that contracts with incentive programs were necessary for farmers to adopt BMPs. In addition, factors that influenced adoption included socio-economic and financial variables, level of education attained by the farmer, the presence of an heir, net farm income, and the farmer’s affinity for the environment.

The rate of tropical biodiversity loss compelled Langholz et al. to carry out a study that involved the interview of 68 private nature reserve owners to learn more about one of Costa Rica’s incentive programs that promoted conservation of rainforests. Questions asked included the following: To what extent, if any, has the incentive program led to expansion of the formal park system? Has the program been reaching its intended audience? What motivates landowners to sign up for the program? What additional incentives do landowners want and what trade-offs would they make to get them? Does the program offer only a short-term fix, or is there evidence that its effect will persist? Results indicated that, in terms of whether the program had reached its intended audience, 80% of nonparticipant reserve owners knew of the government programs designed to help landowners protect natural areas. Forty-four percent of them, after hearing the description of the program, had heard of a wildlife conservation law but not that particular program. Fifty-four percent of the landowners said they would be interested in joining the program, 20% were not interested, and the remainders were undecided. The study also examined the extent to which those incentives were being utilized by landowners and honored by the government. Seventy-three percent of the landowners said they had not yet evoked the squatter’s protection incentive. Forty-one percent of the landowners asked for assistance. Ninety-one percent of the program participants stated that they planned to continue with the program. Only one owner wanted to leave the program.
Copper and Keim carried out a study on incentive payments to encourage farmer adoption of water quality protection practices. The study examined five management practices: integrated pest management, legume crediting, manure testing, split application of nitrogen and soil moisture testing. Variables used in the analysis included total acres operated, level of education of the operator, operator years of experience, operator net farm income, number of days annually the operator worked off the farm, type of farm owned by the operator and farm location. Results indicated that number of days annually the operator worked off the farm negatively influenced adoption. However, in general, for level of education, only one of the coefficients estimated for the management practices was negative. As such, the results indicated that the higher the level of education of the farmer, the more likely he was to adopt the practice. Total acres operated had two of the coefficient signs negative. Operator’s years of experience had only one of the coefficients with a negative sign, indicating that the greater the experience, the less likely the farmer was to adopt the practice. Operator’s net farm income had one negative sign, indicating that the higher the net farm income, the more likely the operator was to adopt the practices. The variable, type of farm owned by the operator, had only one of the coefficients with a negative sign, indicating that the type of farm affected adoption of the management practices. Farm location also influenced the decision to adopt the management practice. Farmers could thus be encouraged to voluntarily adopt environmentally sound management practices through the use of incentive payments.
CHAPTER 3
ANALYTICAL TECHNIQUE AND DATA

This chapter is made up of three sections; the first gives a description of the analytical technique. The second gives a description of the survey results, dependent and independent variables used in the analysis, and the final section consists of tests carried out in the Analysis.

3.1 ANALYTICAL TECHNIQUE

3.1.1 The Qualitative Discrete Choice Model

The qualitative discrete choice model is a powerful analytical technique for understanding an individual’s wants (Greene, 2000). It predicts the decision made by an individual, \( Y \) (choice of mode, choice of route, etc.) as a function of any number of variables, \( X \). Assuming an individual chooses from among alternatives that provide different levels of utility, then the utility function at the level \( z \) can be represented as:

\[
Y_z = \beta_0 + \beta_x z + \varepsilon_z (Z=1, 2, 3 \ldots z),
\]

where \( \beta \) represents parameter estimates of the explanatory variables, \( \beta_0 \) is a constant and the intercept, and \( \varepsilon \) is the error term containing all other unobserved variables that affect the decision made (Mirer; Hill et al.). The qualitative discrete choice model was proposed for this study because it has certain advantages over other analytical tools: (1) a discrete choice experiment may resemble more closely the actual situation; (2) it can be designed to allow different features for different variables; (3) it allows for the evaluation of a set of alternatives rather than evaluating them one at a time; (4) it allows for choices to be modeled directly and not inferred or derived; (5) the “not chosen” option of a discrete choice model allows for the estimation of the impact of a situation not occurring; and (6) it assumes that choices made by individuals can be predicted based on a limited set of quantifiable factors and that people are essentially rational.
decision-makers who seek to make choices that maximize their utility (Greene, 2000). The relationship between the underlying factors and the probability of the individual choosing a particular alternative is assumed to bear a particular functional form such as a logit or probit function (Hill et al.). Discrete choice models have been used in many studies, some of which are Coble et al., who applied a binomial probit model to examine multiple peril crop insurance demand; Cooper and Keim, who used a discrete choice model to predict farmer adoption of BMPs as a function of a payment offer; Smith and Baquet., who carried out an analysis of the demand for multiple peril crop insurance for wheat farms; Zabel, who analyzed the relationship between hours of work and labor force participation; Brox et al., who analyzed item nonresponse in contingent valuation surveys when estimating willingness to pay for improved water quality; Thornton, who used logit models to examine the influence of economic and non-economic factors on the choice of medical specialty by new physicians; Morey et al., who used a repeated three-level nested logit model to examine the participation and site choice for Atlantic salmon fishing; and Kilkenny and Huffman, who determined how labor force and income support program participation varies across midwestern rural and urban areas.

3.1.2 The Sequential Response Model (Sequential Analysis)

The specific model used for this study is the sequential response discrete choice model. Johnson mentioned that during the early 1940’s to late 1950’s, there was no recognized field of statistical theory known as sequential analysis. However, a variety of ad hoc sequential sampling methods in response to many specific problems were constructed. The sequential probability ratio test, s.p.r.t, which is based on the likelihood ratio, gave rise to sequential analysis. The s.p.r.t procedure is said to provide a starting point for the construction of other tests in many specific problems. It has been observed that recent sequential procedures have been introduced in
the context of comparative clinical trials where an estimate of treatment difference, accompanied by a confidence interval, will usually be required (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).

Sequential response models are of two types. The first depends on whether the treatment sequence is fixed and the second depends on whether the selection of the treatment of the next experimental unit or group of units depends upon the previous results (Andrews and Herzberge). The second model type is chosen for this study. This sequential analysis involves five levels and each level (except for the first) depends on previous results.

In many sequential analyses where the outcome is discrete instead of continuous, simple regression methods such as ordinary least squares are not suitable. The ordinary least squares results are inefficient and biased. Logit models are normally used in analyses with discrete outcome variables, \( y_z \). A logit model assumes that there is a continuous unobserved dependent variable \( y_z^* \) that is linearly related to various explanatory variables and also linked with the observed discrete outcome variable, \( y_z \), by a link function. This link function describes the probability that \( y_z \) takes on a particular value, given the value of \( y_z^* \) (Chiu and Khoo).

Limitations associated with the sequential logit model are 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 \( R^2 \):

\[
N > \left[ 8(1-R^2) / R^2 \right] + (m-1).
\]
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 LIMDEP (Greene, 1995) software would be used in running four levels of binary logit models where the first level is estimated from the entire sample, then subsequent ones from the subsample 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 (Greene, 2000):

\[
F(x) = \frac{1}{1 + e^{-x}}
\]

where \(e^{-x}\) is the same as \(\exp(x)\), notation that is used later in this thesis.

The probability, \(P\), that an individual chooses alternative \(k\) over alternative \(m\) at level \(z\) is given as:

\[
P_z = P[y_{zk} \geq y_{zm}]
\]

where \(m \neq k\).

\[
P_z = P[\beta'x_{zk} \geq \beta'x_{zm}]
\]

where \(m \neq k\), \(\beta'x = \beta_0 + \beta x\), \(\epsilon_z = 0\) and variance=\(\delta^2\). Thus, for a logit model where \(y_z = 1\),

\[
P(y_z = 1 \mid x') = (F\beta'x_z) = \frac{1}{1 + \exp(\beta'x_z)}
\]

(2)

and where \(y_z = 0\),

21
\[
P(y_z=0 \mid x') = (1 - F(\beta' x_z)) = \frac{\exp(\beta' x_z)}{1 + \exp(\beta' x_z)}
\]

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:

\[
P_0 = [1 - F(\beta' x_1)]
\]

\[
P_0 = \frac{\exp(\beta' x_1)}{1 + \exp(\beta' x_1)}
\] \hspace{1cm} (4)

\[
P_1 = F(\beta' x_1)[1 - F(\beta' x_2)]
\]

\[
P_1 = \frac{1}{1 + \exp(\beta' x_1)} \ast \frac{\exp(\beta' x_2)}{1 + \exp(\beta' x_2)}
\] \hspace{1cm} (5)

\[
P_2 = F(\beta' x_1) F(\beta' x_2) [1 - F(\beta' x_3)]
\]

\[
P_2 = \frac{1}{1 + \exp(\beta' x_1)} \ast \frac{1}{1 + \exp(\beta' x_2)} \ast \frac{\exp(\beta' x_3)}{1 + \exp(\beta' x_3)}
\] \hspace{1cm} (6)

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

\[
P_3 = \frac{1}{1 + \exp(\beta' x_1)} \ast \frac{1}{1 + \exp(\beta' x_2)} \ast \frac{1}{1 + \exp(\beta' x_3)} \ast \frac{\exp(\beta' x_4)}{1 + \exp(\beta' x_4)}
\] \hspace{1cm} (7)

\[
P_4 = F(\beta' x_1) F(\beta' x_2) F(\beta' x_3) F(\beta' x_4)
\]

\[
P_4 = \frac{1}{1 + \exp(\beta' x_1)} \ast \frac{1}{1 + \exp(\beta' x_2)} \ast \frac{1}{1 + \exp(\beta' x_3)} \ast \frac{1}{1 + \exp(\beta' x_4)}
\] \hspace{1cm} (8)

where * represents a multiplication sign. \(\beta_z\) are the sequential analysis coefficient estimates for the individual explanatory variables at each level \(z\). The individual \(\beta_z\)'s can be obtained using the estimator, \(f(y) = p^y (1-p)^{1-y}\), where \(y = [0,1]\) and \(p\) is the probability that \(y\) takes the value 1 (Hill et al.; Greene, 2000).
Having derived the probabilities for the sequential response model, there is the need to examine the effect of one-unit changes in the explanatory variables on the dependent variables $y_z$, i.e., the marginal effects.

### 3.1.3 Marginal Effects

Marginal effects are nonlinear functions of the parameter estimates and the levels of the explanatory variables that cannot be inferred directly from the parameter estimates (Anderson and Newell). Determining the marginal effect of a dummy variable is different from that of a continuous variable. The marginal effects for dummy variables can be derived using different methods, one of which follows. 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. In order 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 (4) to (8) 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, ME:

$$
\Delta P_z = P[y_z \mid x_t=1] - P[y_z \mid x_t=0] \quad \text{(Greene, 2000)}.
$$

The above equation can be rewritten as equation (9):

$$
ME_z = \frac{1}{1+\exp(\beta'x_{Z+1})} - \frac{\exp(\beta'x_{Z+1})}{1+\exp(\beta'x_{Z+1})} \quad \text{(9)}
$$

The marginal effects for continuous variables are obtained by taking derivatives of the predicted probabilities for the individual variables (Maddala). Using calculus, the derivatives of
equations (2) and (4) are obtained as follows. The quotient rule in calculus states that for a given function \( f(x) = \frac{u}{v} \), its derivative is:

\[
\frac{\partial}{\partial x} \left[ \frac{u}{v} \right] = \frac{\frac{\partial u}{\partial x} v - u \frac{\partial v}{\partial x}}{v^2}
\]

As such, the derivative of (2) is derived as:

\[
\frac{\partial}{\partial x} (F(\beta' x_z)) = \frac{\partial}{\partial x} \left( \frac{1}{1 + \beta' x_z} \right)
\]

\[
\frac{\partial}{\partial x} (F(\beta' x_z)) = \frac{\partial}{\partial x} \left[ \frac{1 + \exp(\beta' x_z)}{(1 + \exp(\beta' x_z))^2} \right]
\]

The chain rule for an exponential function, \( F(x) = e^{fx} \) where \( fx \) is a differential function, is given as (Tan; Riddle):

\[
\frac{\partial}{\partial x} e^{(fx)} = e^{(fx)} \frac{\partial}{\partial x} (fx)
\]

thus,

\[
\frac{\partial}{\partial x} (F(\beta' x_z)) = \frac{\partial}{\partial x} \left( \frac{1 + \exp(\beta' x_z)}{(1 + \exp(\beta' x_z))^2} \right)
\]

Going through the same calculation process as for equation (10) above, the derivative of equation (2) will give rise to equation (11) below:

\[
\frac{\partial}{\partial x} (1 - F(\beta' x_z)) = \frac{\exp(\beta' x_z) \beta_z k}{(1 + \exp(\beta' x_z))^2} [1 - f((\beta' x_z))] \beta' x_z
\]

Thus, with the help of equations (10) and (11) and the product rule which states that, for a given function, \( f(x) = UVW \),
\[
\frac{\partial [f(x)]}{\partial x} = \frac{VW \partial (U)}{\partial x} + \frac{UW \partial (V)}{\partial x} + \frac{U V \partial (W)}{\partial x} \quad (Tan) \]

The derivatives of equations (4) to (8) are as follows, respectively:

\[ ME_0 = \partial [1-F(\beta'x_1)]/ \partial x \quad (12) \]

\[ ME_0 = [1-f(\beta'x_1)] \beta_1 k \]

\[ ME_0 = \left[ \frac{\exp(\beta'x_1) \beta_1 k}{[1+\exp(\beta'x_1)]^2} \right] \quad (12) \]

\[ ME_1 = \left[ \frac{\partial (F(\beta'x_1))}{\partial x} + \partial (1-F(\beta'x_2))/ \partial x \right] \quad (13) \]

\[ ME_1 = \{F(\beta'x_1) [1-f(\beta'x_2) \beta_2 k] \} + \{[1-F(\beta'x_2)] f(\beta'x_1) \beta_2 k \} \]

\[ ME_1 = \left[ \frac{1}{1+\exp(\beta'x_1)} \right] \left[ \frac{\exp(\beta'x_2) \beta_2 k}{[1+\exp(\beta'x_2)]^2} \right] \left[ \frac{\exp(\beta'x_2) \beta_3 k}{[1+\exp(\beta'x_2)]^2} \right] \quad (13) \]

\[ ME_2 = \{\partial F(\beta'x_1)/\partial x\} + \{\partial F(\beta'x_2)/\partial x\} + \{\partial [1-F(\beta'x_3)]/\partial x\} \quad (14) \]

\[ ME_2 = \{F(\beta'x_1)F(\beta'x_2)[1-f(\beta'x_3) \beta_3 k] \} + \{F(\beta'x_1) f(\beta'x_2) \beta_2 k [1- F(\beta'x_3)] \} + \{f(\beta'x_1) \beta_1 k F(\beta'x_2)[1- F (\beta'x_3)] \} \]

(Equation 14 continued on the next page)
\[ ME_2 = \begin{pmatrix} 1 \\ \frac{1}{1 + \exp(\beta' x_1)} \end{pmatrix} \begin{pmatrix} \exp(\beta' x_3) \beta_{3k} \\ \frac{1}{1 + \exp(\beta' x_3)} \end{pmatrix} \begin{pmatrix} \frac{\exp(\beta' x_3) \beta_{3k}}{1 + \exp(\beta' x_3)} \\ \frac{1}{1 + \exp(\beta' x_3)} \end{pmatrix} \]

\[ - \begin{pmatrix} 1 \\ \frac{1}{1 + \exp(\beta' x_2)} \end{pmatrix} \begin{pmatrix} \exp(\beta' x_3) \\ \frac{1}{1 + \exp(\beta' x_3)} \end{pmatrix} \begin{pmatrix} \frac{\exp(\beta' x_2) \beta_{2k}}{1 + \exp(\beta' x_2)} \\ \frac{1}{1 + \exp(\beta' x_2)} \end{pmatrix} \]

\[ - \begin{pmatrix} 1 \\ \frac{1}{1 + \exp(\beta' x_2)} \end{pmatrix} \begin{pmatrix} \exp(\beta' x_3) \\ \frac{1}{1 + \exp(\beta' x_3)} \end{pmatrix} \begin{pmatrix} \frac{\exp(\beta' x_1) \beta_{1k}}{1 + \exp(\beta' x_1)} \\ \frac{1}{1 + \exp(\beta' x_1)} \end{pmatrix} \]

\[ \text{ME}_3 = \frac{\partial F(\beta' x_1)}{\partial x} + \frac{\partial F(\beta' x_2)}{\partial x} + \frac{\partial F(\beta' x_3)}{\partial x} + \frac{\partial (1 - F(\beta' x_4))}{\partial x} \]  

\[ \text{ME}_3 = \{ F(\beta' x_1) F(\beta' x_2) F(\beta' x_3) \left[ (1 - f(\beta' x_4) \beta_{4k}) \right] + \{ F(\beta' x_1) F(\beta' x_2) f(\beta' x_3) \beta_{3k} \[1 - F(\beta' x_4)] \} + \{ F(\beta' x_1) f(\beta' x_2) \beta_{2k} F(\beta' x_3) [1 - F(\beta' x_4)] \} + \{ f(\beta' x_1) \beta_{1k} F(\beta' x_2) F(\beta' x_3) [1 - F(\beta' x_4)] \} \}

(Equation 15 continued on the next page)
\[
\text{ME}_3 = \left[ \begin{array}{c}
\frac{1}{1 + \exp(\beta' x_1) + \exp(\beta' x_2) + \exp(\beta' x_3)} \\
\frac{\exp(\beta x_4) \beta_{4k}}{[1 + \exp(\beta' x_4)]^2}
\end{array} \right]
\]

\[
= \left[ \begin{array}{c}
\frac{1}{1 + \exp(\beta' x_1) + \exp(\beta' x_2) + \exp(\beta' x_3)} \\
\frac{\exp(\beta x_3) \beta_{3k}}{[1 + \exp(\beta' x_3)]^2}
\end{array} \right]
\]

\[
= \left[ \begin{array}{c}
\frac{1}{1 + \exp(\beta' x_1) + \exp(\beta' x_2) + \exp(\beta' x_3)} \\
\frac{\exp(\beta x_2) \beta_{2k}}{[1 + \exp(\beta' x_2)]^2}
\end{array} \right]
\]

\[
= \left[ \begin{array}{c}
\frac{1}{1 + \exp(\beta' x_1) + \exp(\beta' x_2) + \exp(\beta' x_3)} \\
\frac{\exp(\beta x_1) \beta_{1k}}{[1 + \exp(\beta' x_1)]^2}
\end{array} \right]
\]

(15)

\[
\text{ME}_4 = \frac{\partial F(\beta' x_1)}{\partial x} + \frac{\partial F(\beta' x_2)}{\partial x} + \frac{\partial F(\beta' x_3)}{\partial x} + \frac{\partial F(\beta' x_4)}{\partial x}
\]

(16)

\[
\text{ME}_4 = \{ F(\beta' x_1) F(\beta' x_2) F(\beta' x_3) (f(\beta' x_4) \beta_{4k}) \} + \{ F(\beta' x_1) F(\beta' x_3) f(\beta' x_4 \beta_{3k}) \}
\]

\[
F(\beta' x_4) + \{ F(\beta' x_1) f(\beta' x_2) \beta_{2k} F(\beta' x_3) F(\beta' x_4) \} + \{ f(\beta' x_1) \beta_{1k} F(\beta' x_2) \}
\]

\[
F(\beta' x_3) F(\beta' x_4)
\]

(Equation 16 continued on the next page)
3.1.4 Standard Errors

Whitehead observed that the estimated variance for a sequential analysis could be calculated from the data since its value would not be altered by the fact that the test was conducted sequentially. Thus, the standard errors of the parameter estimates calculated for the sequential response model can be determined. The square root of the variance, \( \sigma_x^2 \), of a variable \( x_z \) gives rise to the standard error, \( \text{se}(x) \) (Ramanathan; Greene, 2000):

\[
\text{se}(x) = \sqrt{\sigma_x^2}
\]  

However, the covariance, \( \rho \), divided by \( \sigma_x^2 \), gives rise to the estimated parameter, \( \beta_z \) (Mirer; Hill et al.; Wooldridge):

\[
\beta_z = \frac{\rho}{\sigma_x^2} \quad \text{and} \quad \sigma_x^2 = \frac{\rho}{\beta_z}.
\]
Thus, equation (17) can be rewritten as:

\[ se(x) = \frac{\sqrt{\rho}}{\sqrt{\beta_z}} \]  

(18)

The t-statistic determines whether a variable, \( x_z \), is significant. The t-statistic estimator is calculated as follows:

\[ t\text{-stat} = \frac{\beta_z \cdot H_0}{\sigma} \]  

(19)

where \( H_0 \) is the null hypothesis. Thus, if \( H_0: \beta = 0 \), then equation (19) can be stated as:

\[ t\text{-stat} = \frac{\beta_z}{se(x)} \]  

(20)

### 3.2 SURVEY AND DESCRIPTION OF INDEPENDENT VARIABLES

In summer, 2003, 1,500 cattle producers in Louisiana were surveyed to determine their knowledge of EQIP, adoption of BMPs, and willingness to accept EQIP cost-share payments for the adoption of rotational grazing (Kim et al.). 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 out, 504 were returned completed while 270 were returned incomplete. Guidelines provided by Dillman for maximizing return rate were considered. The overall return rate was 41%.

In the present study, the dependent variables are represented as follows: \( EQIP_z \) 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\textsubscript{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\textsubscript{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 analysis, 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 2 shows the units and definitions of the explanatory variables and Table 3 gives the expected signs for the logit and sequential models. LOWNED is the ratio of the land owned by the farmer used in the beef cattle operation divided by the acres of land devoted exclusively to the beef cattle operation. Four-hundred ninety-four cattle operators answered this survey question. Brox et al. observed that an increase in the ownership of land increased the willingness to pay for improved water quality. It is expected that producers owning a greater percentage of the land for their cattle operation are more likely to be aware of EQIP since this program is aimed at improving the environment, which includes improved water quality. Producers who own a greater portion of their farmland are expected to have greater interest in programs that would eventually lead to long-run productivity where the benefits accrue directly to the landowner (Gates; Hatcher). These farmers are, thus, more likely to apply to the program and less likely to cancel the program if accepted.

FARMSTRM represents whether a stream runs through the farm. A value of 1 indicates that a stream runs through the farm and 0 indicates the stream is more than a mile away from the farm or that the nearest stream to the farm is less than or equal to a mile away.
**TABLE 2: SUMMARY OF UNITS AND DEFINITIONS OF THE EXPLANATORY VARIABLES**

<table>
<thead>
<tr>
<th>Variable</th>
<th>units</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWNED</td>
<td>ratio</td>
<td>Land owned by farmer</td>
</tr>
<tr>
<td>NRCS</td>
<td>0-1 (dummy)</td>
<td>Number of times a farmer met with NRCS officials in 2002:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = ≥ 4 times and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = 0-3 times</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>0-1 (dummy)</td>
<td>How close the farm is to a stream:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = ≤ 1 mile and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = &gt; 1 mile</td>
</tr>
<tr>
<td>NAGE</td>
<td>years</td>
<td>Age of the farmer reduced by a factor of 10</td>
</tr>
<tr>
<td>HS</td>
<td>0-1 (dummy)</td>
<td>Level of farmers education:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = no high school diploma</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = high school diploma or higher</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>%</td>
<td>Percentage of net household income that comes from the beef production</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>1-7</td>
<td>Number of enterprises owned by the farmer</td>
</tr>
<tr>
<td>LCES</td>
<td>0-1 (dummy)</td>
<td>Number of times a farmer met with LCES agents in 2002:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = more than 4 times and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = otherwise.</td>
</tr>
<tr>
<td>HELA</td>
<td>0-1 (dummy)</td>
<td>1 = land has been declared “highly erodible” by NRCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = land has not been declared “highly erodible” by NRCS</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>Acres/100</td>
<td>Total acres of land used in cattle operation, divided by 100</td>
</tr>
<tr>
<td>MALE</td>
<td>0-1 (dummy)</td>
<td>0 = Female</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Male</td>
</tr>
</tbody>
</table>

Four-hundred ninety-six cattle operators answered this question. Farmers with streams running through their farms are at greater risk of polluting streams and would be targeted by groups concerned about environmental quality. Thus, these farmers are expected to be more aware of EQIP due to their resultant greater contact with regulatory agencies. In the case of higher cost associated with implementing conservation plans, these farmers are expected to participate in EQIP (Nickerson and Lynch). Thus, nearness of a farm to a stream is expected to positively influence a farmer’s knowledge of EQIP, his application to the program, the probability of being accepted and the farmer’s subsequent adoption of BMPs under EQIP.

NAGE represents the actual age of the farmer divided by ten. Four-hundred eighty-five cattle operators indicated their age. Age is often used in technology adoption studies, with results
frequently showing negative impacts on adoption (e.g., Brox et al., Kilkenny et al., Roberts and Key). Some farmers are likely to become comfortable with existing management practices, and do not have the incentive to invest greatly in technology that they may not use for an extended time period (especially if they plan on retiring soon). As such it is expected that older farmers would be less likely to apply to and adopt BMPs under EQIP. However, for older farmers who do apply, it is indeterminate a priori whether they would be more or less likely to be accepted or would cancel later.

HS represents the holding of a high school diploma by the farmer. The variable is coded as 0 if the farmer has education less than high school and 1 if the level of education of the farmer is high school and higher. Four-hundred ninety-nine cattle farmers indicated their level of education. Foltz and Chang; Nickerson and Lynch; and Smith and Baquet showed that farmers’ level of education positively influenced adoption. Educated farmers are more likely to be aware of EQIP since they are generally more likely to be informed of programs and technology. Based on the studies mentioned above, it is expected that more highly educated farmers are more likely to apply to EQIP, and less likely to cancel the program if accepted.

PBEEFINC is the percentage of household net income from the beef operation, with five outcomes of 20% intervals from less than 20% to 100%. Five-hundred and four cattle operators answered this survey question. Other studies conducted on the adoption of technology, programs and water quality show that farmers with higher percentages of household net income from their farm operations are expected to have greater knowledge of technology and programs (Foltz and Chang; Nickerson and Lynch; Smith and Baquet). It is expected that farmers with higher percentages of household net income would seek information about their businesses that would ensure a steady flow of income. Thus, a higher percentage of household net income from the
beef operation is expected to positively influence the awareness of EQIP and application to the program.

DIVERSE represents the number of enterprises other than cattle on the farm. The values for this variable range between 0 and 7 for the surveyed farmers. A value of 0 indicates that the farmer did not deal in any other agricultural enterprise besides cattle. Five-hundred-three farmers answered this survey question. Farmers with greater numbers of enterprises are expected to more likely have utilized EQIP, since they may have adopted conservation practices for another enterprise using the program (Hatcher). More diversified farmers are, thus, expected to have greater awareness of EQIP, to more likely have applied to the program and to more likely have adopted BMPs under the program.

NFARMAC is the number of acres of land that make up the entire farm operation, divided by 100 for estimation purposes. Foltz and Chang observed that in the adoption of technology by dairy farmers, larger farms were more likely to have adopted since implementing BMPs on larger farms would be more cost effective. It is, thus, expected that producers who operate larger parcels of land for their entire farm operations are more likely to be informed of EQIP, more likely to apply for EQIP funds and to have greater interest in conservation practices.

NRCS is a dummy variable indicating the farmer had business contact with the Natural Resource Conservation Service (NRCS) at least four times in the year 2002. NRCS personnel have the major responsibility of dissemination of information on EQIP. Thus, farmers who have been in contact with NRCS personnel are more likely to have heard of EQIP, are more likely to apply and be accepted, and more likely to subsequently adopt BMPs under EQIP.

LCES is a dummy variable indicating the farmer had business contact with the Louisiana Cooperative Extension Service at least 4 times in 2002. LCES agents, like NRCS personnel,
have responsibility for dissemination of information involving BMPs to farmers. Thus, farmers
who have been in contact with LCES agents are more likely to have heard about EQIP, are more
likely to apply and if accepted, to adopt BMPs under EQIP.

HELA is a dummy variable indicating the farmer had land classified as “highly erodible”
by NRCS. In the 1930’s, much US farmland was subjected to moderate to severe erosion. When
conservation programs were put in place, awareness developed among farmers, and soon, farm
families were operating using greater conservation practices (Saloutos). A “highly erodible” farm
requires BMPs to preserve the land. It is expected that farmers with “highly erodible” lands are
more likely to apply to EQIP and be accepted. The probability of canceling the program later is
expected to be low.

MALE represents the gender of the farmer, with 0 representing female and 1 representing
male. Brox et al. and Paudel et al.’s studies on the willingness to pay for amenities such as water
quality and recreational facilities indicated that men were more likely to pay to improve water
quality and, as such would go the extra length to seek information. In studies in developing
countries men have been the major owners of land due to bias in land allocation and inheritance
and as such, have been the more likely technology adopters (Akinwumi and Chianu; Doss and
morris). However for a program like EQIP that provides farmers with funding to protect the
environment, it would be expected that both females and males would both be interested i.

The expected signs for the variables in the sequential models (Table 3) can be derived
using reasoning based on the expected signs of the variables for the logit models in Table 3 if:
(1) $EQIP_0 = KNEQIP_0$. Based on the signs for KNEQIP independent variables in Table 3, it is
expected that the variables in the model $EQIP_0$ would be the opposite of those in the KNEQIP
model. (2) $EQIP_1 = (KNEQIP_1)$ (APEQIP=0). This represents the probability of a farmer
knowing about but not applying to the EQIP. As such, the variables in the model EQIP_1 would be expected to be the opposite in sign of those in the APEQIP model.

**TABLE 3: SUMMARY OF THE EXPECTED SIGNS OF EXPLANATORY VARIABLES FOR THE SEQUENTIAL AND THE LOGIT MODELS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>units</th>
<th>KNEQIP</th>
<th>APEQIP</th>
<th>PEQIP</th>
<th>CNEQIP</th>
<th>EQIP_2</th>
<th>EQIP_3</th>
<th>EQIP_4</th>
<th>EQIP_5</th>
<th>EQIP_6</th>
<th>EQIP_7</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWNED</td>
<td>ratio</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NRCS</td>
<td>0-1 (dummy)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RSTRM</td>
<td>0-1 (dummy)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HS</td>
<td>0-1 (dummy)</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>%</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>1-7</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LCES</td>
<td>0-1 (dummy)</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>HEFA</td>
<td>0-1 (dummy)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>Acres/100</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>+</td>
</tr>
</tbody>
</table>

(3) EQIP_2 = (KNEQIP=1) (APEQIP=1) (PEQIP=0). This represents the probability of a farmer knowing of EQIP, applying for EQIP funds, but not receiving EQIP funding. Variables in the model EQIP_2 are expected to have signs opposite to those in the PEQIP model.

(4) EQIP_3 = (KNEQIP=1) (APEQIP=1) (PEQIP=1) (CNEQIP=0). This represents the probability of a farmer knowing of EQIP, applying for EQIP funds, being accepted, and not canceling EQIP later. The variables in the EQIP_3 model are expected to have signs opposite to those in the CNEQIP model. Finally,

(5) EQIP_4 = (KNEQIP=1) (APEQIP=1) (PEQIP=1) (CNEQIP=1). This represents the probability of a farmer knowing of EQIP, applying for EQIP funds, being accepted, but canceling EQIP
later. As such, variables in this mode are expected to have signs that are the same as those for the CNEQIP model.

3.3 TESTS CARRIED OUT IN THE ANALYSIS

Additional tests carried out in this study were for heteroskedasticity and multicollinearity.

3.3.1 Heteroskedasticity

It is assumed that in a linear regression model, the error terms $\varepsilon_z$ are homoskedastic; i.e., that all the observations used in the model have the same variance, $\sigma^2_{\varepsilon z} = \sigma^2 z$. However, when the variances across observations vary, it is said that there is a problem of heteroskedasticity. If heteroskedasticity is not corrected, the standard errors, SE, estimated for the model are not correct, thus affecting the hypothesis tests. F-tests are usually unreliable under heteroskedasticity. Heteroskedasticity is more likely to occur using cross sectional and panel data than time series data (Ramanathan; Mittelhammer et al; Wooldridge; Hill et al.). Generally, heteroskedasticity can be detected by examining the residuals when the model is run using ordinary least squares (OLS) and the residuals are plotted against the different independent variables or the predicted dependent variables. In this study, the Park test is used to test for heteroskedasticity (Hill et al.).

Using the Park test, the variance is regressed on the independent variables:

$$\ln(\sigma^2 z) = b_1 + b_2 \ln x_z + v_z.$$  

If $b_2$ is significantly different from 0, then there is a problem of heteroskedasticity. In the absence of the variance, the squared residuals can be used:

$$\ln(\varepsilon^2 z) = b_1 + b_2 \ln x_z + v_z.$$  

Heteroskedasticity can be remedied by using weighted least squares when the standard deviation $\sigma z$ is known (Hill et al.).
3.3.2 Multicollinearity

Multicollinearity is a data problem that can pose estimation difficulties in measuring processes such as technology adoption (Mittelhammer et al.). For a model that consists of more than one independent variable, some of these variables may correlate, resulting in larger variances and, thus, causing the problem of multicollinearity. There are two types of multicollinearity. (1) Perfect correlation is where the correlation is 1, which results in serious failure of the assumptions of the model. The only remedy for this type of problem is to drop one of the variables. (2) Near multicollinearity is where the variables are not perfectly correlated (Rammathan). Serious multicollinearity reduces the precision of parameter estimates to the extent that confidence in their signs and magnitudes is very low and severe statistical problems may arise (Mittelhammer et al.). Other signs that indicate the presence of multicollinearity are: (1) it is difficult to separate the individual effects of the model components; (2) small changes in the data produce wide swings in the parameter estimates; (3) coefficients may have very high standard errors and low significance levels; (4) the $R^2$ of the model is quite high; and (5) coefficients may have the wrong signs (Ramanathan; Mittelhammer et al.; Wooldridge).

Multicollinearity can be determined in several ways, some of which are as follows: the correlation coefficient is a measure of the degree of relationship between variables (Berkson). It is obtained in a least-squares fit of a regression line. The correlation coefficient can be determined using the estimator:

$$r = \sqrt{1 - \frac{\sigma_{xy}^2}{\sigma_x^2}}$$

where $r$ is the correlation coefficient, $\sigma_x$ is the standard deviation of $x$, and $\sigma_{xy}$ is the partial standard deviation of $x$ given $y$ (Berkson). The correlation coefficient must vary from zero to one in absolute values. The smaller $r$ is, the poorer the agreement with the line of regression. If $r = 1$,
the value of $y$ falls exactly on the line of regression and the correlation is said to be perfect. On the other hand, if $r = 0$, the line of regression coincides with the x-axis, suggesting that the value of $y$ is its own deviation from the line of regression, indicating that there is no correlation (Roeser). Correlation between variables is said to be strong if the value of $r$ is 0.8 or greater. In order to correct for high correlation between independent variables, one of them is generally dropped from the model.

The variance inflation factor, VIF, is calculated as:

$$VIF = \frac{1}{1 - R^2}.$$  

Using this method, each independent variable is regressed against each other variable to obtain the VIF. A value of VIF in excess of five indicates the presence of multicollinearity (Kennedy).

Finally, the Collins test involves determining the Condition number or index (CI). A CI value in excess of 20 indicates the presence of multicollinearity. The correlation coefficient, VIF and CI were used in this study to determine whether multicollinearity existed (Kennedy).
CHAPTER 4
RESULTS AND DISCUSSION

This chapter reports and discusses the econometric model, including the diagnostic results of the heteroskedasticity and multicollinearity tests; and the results of the logit and sequential logit models.

4.1 HETEROSKEDASTICITY TEST RESULTS

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 (Table 4).

<table>
<thead>
<tr>
<th>Variable</th>
<th>ME</th>
<th>St. Error</th>
<th>t-stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWNED</td>
<td>-2.94E-03</td>
<td>1.41E-02</td>
<td>-0.208</td>
<td>0.8354</td>
</tr>
<tr>
<td>NRCS</td>
<td>-3.83E-03</td>
<td>1.35E-02</td>
<td>-0.284</td>
<td>0.7763</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>7.22E-05</td>
<td>4.10E-03</td>
<td>0.018</td>
<td>0.9860</td>
</tr>
<tr>
<td>NAGE</td>
<td>-6.33E-04</td>
<td>1.89E-03</td>
<td>-0.335</td>
<td>0.7373</td>
</tr>
<tr>
<td>HS</td>
<td>1.95E-03</td>
<td>6.06E-03</td>
<td>0.322</td>
<td>0.7473</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>-2.65E-03</td>
<td>1.15E-02</td>
<td>-0.230</td>
<td>0.8178</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>-3.15E-03</td>
<td>9.14E-03</td>
<td>-0.345</td>
<td>0.7303</td>
</tr>
<tr>
<td>LCES</td>
<td>6.57E-03</td>
<td>1.85E-02</td>
<td>0.356</td>
<td>0.7222</td>
</tr>
<tr>
<td>HE LA</td>
<td>2.00E-02</td>
<td>5.80E-02</td>
<td>0.345</td>
<td>0.7299</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>-1.14E-03</td>
<td>3.46E-03</td>
<td>-0.328</td>
<td>0.7426</td>
</tr>
<tr>
<td>MALE</td>
<td>1.41E-04</td>
<td>2.49E-02</td>
<td>0.006</td>
<td>0.9955</td>
</tr>
</tbody>
</table>

4.2 MULTICOLLINEARITY TEST RESULTS

Table 5 gives the correlation coefficients for the explanatory variables. It can be observed from the results that there is very little correlation between the explanatory variables. The highest correlation coefficient is 0.429, between LCES and NRCS. However, this is well below the “rule of thumb” critical level of 0.80 (Kennedy). These results suggest that multicollinearity is not
problematic in the model. However, variance inflation factors (VIF) and the Collins test (CI) provide further insight.

Results of the VIF and CI are displayed in Tables 6 and 7. It can be observed that the VI values are less than 5 for all of the explanatory variables. This indicates that the VI test did not detect multicollinearity in the data for any of the equations.

<table>
<thead>
<tr>
<th>Variables</th>
<th>LOWNED</th>
<th>NRCS</th>
<th>FARMSTRM</th>
<th>AGE</th>
<th>COLLE</th>
<th>PBEFINC</th>
<th>DIVERSE</th>
<th>LCES</th>
<th>HELA</th>
<th>NFARMAC</th>
<th>MALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWNED</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRCS</td>
<td>-0.02222</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>-0.09738</td>
<td>-0.01722</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAGE</td>
<td>0.15512</td>
<td>-0.10721</td>
<td>-0.06603</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS</td>
<td>-0.01741</td>
<td>0.05065</td>
<td>-0.04718</td>
<td>-0.24837</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBEFINC</td>
<td>-0.08342</td>
<td>0.04273</td>
<td>-0.04399</td>
<td>0.01123</td>
<td>0.04662</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIVERSE</td>
<td>0.06268</td>
<td>0.19060</td>
<td>-0.01984</td>
<td>-0.09581</td>
<td>0.05967</td>
<td>0.08660</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCES</td>
<td>-0.10257</td>
<td>0.42893</td>
<td>-0.03742</td>
<td>-0.12863</td>
<td>0.06253</td>
<td>0.05709</td>
<td>0.20812</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HELA</td>
<td>0.09296</td>
<td>0.09360</td>
<td>-0.01893</td>
<td>0.03228</td>
<td>0.04311</td>
<td>-0.00922</td>
<td>0.08338</td>
<td>0.03709</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NFARMAC</td>
<td>-0.18415</td>
<td>0.13122</td>
<td>-0.04489</td>
<td>-0.07308</td>
<td>0.04559</td>
<td>0.24475</td>
<td>0.20096</td>
<td>0.07616</td>
<td>0.02628</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MALE</td>
<td>-0.08674</td>
<td>0.06910</td>
<td>-0.00625</td>
<td>0.07380</td>
<td>-0.07902</td>
<td>-0.01644</td>
<td>0.03428</td>
<td>0.03469</td>
<td>0.05718</td>
<td>0.03098</td>
<td>1</td>
</tr>
</tbody>
</table>

However, using the Collins test, the values for one variable in each equation, were greater than 20, as seen in the Table 7. However, Belsky et al. suggested that condition indexes of greater than 100 are the greatest threat to variance inflation and thus, to regression estimates. Since these CI values were less than 100, instead of dropping them, they were left in the model and analyzed.
### TABLE 6: RESULTS OF MULTICOLLINEARITY TEST, TEST VARIANCE INFLATION FACTORS

<table>
<thead>
<tr>
<th>Variable</th>
<th>KNEQIP Variance Inflation</th>
<th>APEQIP Variance Inflation</th>
<th>PEQIP Variance Inflation</th>
<th>CNEQIP Variance Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td>LOWNED</td>
<td>1.15426</td>
<td>1.17019</td>
<td>1.14417</td>
<td>1.25385</td>
</tr>
<tr>
<td>NRCS</td>
<td>1.28253</td>
<td>1.27070</td>
<td>1.28866</td>
<td>1.45129</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>1.04703</td>
<td>1.06054</td>
<td>1.04938</td>
<td>1.20142</td>
</tr>
<tr>
<td>NAGE</td>
<td>1.15565</td>
<td>1.21791</td>
<td>1.15527</td>
<td>1.32263</td>
</tr>
<tr>
<td>HS</td>
<td>1.18505</td>
<td>1.14679</td>
<td>1.18224</td>
<td>1.20475</td>
</tr>
<tr>
<td>PBEFINCN</td>
<td>1.08144</td>
<td>1.08254</td>
<td>1.08428</td>
<td>1.42815</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>1.13063</td>
<td>1.13589</td>
<td>1.13811</td>
<td>1.28581</td>
</tr>
<tr>
<td>LCES</td>
<td>1.15935</td>
<td>1.15605</td>
<td>1.15962</td>
<td>1.28296</td>
</tr>
<tr>
<td>HEFA</td>
<td>1.06174</td>
<td>1.09172</td>
<td>1.06157</td>
<td>1.18738</td>
</tr>
<tr>
<td>NFARMA</td>
<td>1.15796</td>
<td>1.17234</td>
<td>1.16138</td>
<td>1.55459</td>
</tr>
<tr>
<td>MALE</td>
<td>1.07810</td>
<td>1.08834</td>
<td>1.07041</td>
<td>1.14190</td>
</tr>
</tbody>
</table>

Multicollinearity ≥ 5

### TABLE 7: RESULTS OF MULTICOLLINEARITY USING THE COLLINS TEST

<table>
<thead>
<tr>
<th>Number</th>
<th>KNEQIP Condition Index</th>
<th>APEQIP Condition Index</th>
<th>PEQIP Condition Index</th>
<th>CNEQIP Condition Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00000</td>
<td>1.00000</td>
<td>1.00000</td>
<td>1.00000</td>
</tr>
<tr>
<td>2</td>
<td>2.94812</td>
<td>3.06024</td>
<td>2.93904</td>
<td>3.05988</td>
</tr>
<tr>
<td>3</td>
<td>3.05555</td>
<td>3.23714</td>
<td>3.04413</td>
<td>3.34975</td>
</tr>
<tr>
<td>4</td>
<td>3.58712</td>
<td>4.37732</td>
<td>3.56664</td>
<td>5.01363</td>
</tr>
<tr>
<td>5</td>
<td>4.37409</td>
<td>4.86213</td>
<td>4.36436</td>
<td>5.68162</td>
</tr>
<tr>
<td>6</td>
<td>4.98972</td>
<td>5.61736</td>
<td>4.94985</td>
<td>6.68348</td>
</tr>
<tr>
<td>7</td>
<td>5.75690</td>
<td>6.09266</td>
<td>5.73639</td>
<td>7.25875</td>
</tr>
<tr>
<td>8</td>
<td>6.41483</td>
<td>6.90759</td>
<td>6.40224</td>
<td>7.87923</td>
</tr>
<tr>
<td>9</td>
<td>8.17725</td>
<td>8.18588</td>
<td>8.08064</td>
<td>8.50322</td>
</tr>
<tr>
<td>10</td>
<td>8.68981</td>
<td>10.01950</td>
<td>8.67250</td>
<td>12.03187</td>
</tr>
<tr>
<td>11</td>
<td>15.54961</td>
<td>19.23886</td>
<td>15.21748</td>
<td>21.36061</td>
</tr>
<tr>
<td>12</td>
<td>27.23272</td>
<td>29.39546</td>
<td>26.99878</td>
<td>33.65071</td>
</tr>
</tbody>
</table>

Multicollinearity ≥ 20
4.3 NON-SEQUENTIAL MODEL RESULTS

4.3.1 Logit Model Results

There are four models involved in the logit analysis. The models are as follows: KNEQIP, APEQIP, PEQIP and CNEQIP. The probability of a farmer being aware of EQIP is indicated by the results of KNEQIP. The probability of a farmer applying to EQIP is represented by the results APEQIP. PEQIP indicates the results for the probability of a farmer receiving EQIP funding. CNEQIP indicates the results for the probability of a farmer later canceling the EQIP.

Observations with values of 0 for the dependent variable in the previous model are eliminated from the data before the next model is run. For example, only observations where KNEQIP = 1 were used for the model, APEQIP, and likewise for the subsequent models. The sequential nature of the analysis causes the observations to be reduced as one moves from one model to the next. The number of explanatory variables, eleven, is the same for all the models except for CNEQIP, where MALE is eliminated from the model due to estimation problems.

A summary of the descriptive statistics of the explanatory variables for the entire sample of cattle producers completing the questionnaire is given in Table 8. On average, the portion of farmland owned by surveyed cattle farmers in Louisiana was 0.68. Most cattle farms had streams flowing not more than one mile away from the farm. On average, 9% of the farmers surveyed met with NRCS personnel four times or more in 2002. Fourteen percent met with LCES agents four or more times. The average age of a cattle farmer was 59 years, with the age ranging from 23 years to 87 years. Eighty-eight percent of the farmers held a high school diploma. On average, less than 20 percent of farmers’ net household income came from beef production. Only six percent indicated that their farmland used in the cattle operation had been classified by NRCS as
“highly erodible”. The total acres of land making up the entire cattle operation averaged 377 acres. Ninety-five percent of the respondents were males.

### TABLE 8: DESCRIPTIVE STATISTICS OF THE ENTIRE SAMPLE (KNEQIP)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWNED</td>
<td>0.68</td>
<td>0.38</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NRCS</td>
<td>0.09</td>
<td>0.28</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>0.71</td>
<td>0.46</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NAGE</td>
<td>5.86</td>
<td>1.26</td>
<td>2.30</td>
<td>8.7</td>
</tr>
<tr>
<td>HS</td>
<td>0.88</td>
<td>0.33</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>PBEFINC</td>
<td>1.29</td>
<td>0.82</td>
<td>0.00</td>
<td>5.0</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>1.04</td>
<td>1.07</td>
<td>0.00</td>
<td>7.0</td>
</tr>
<tr>
<td>LCES</td>
<td>0.14</td>
<td>0.35</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>HELA</td>
<td>0.06</td>
<td>0.24</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>3.77</td>
<td>7.87</td>
<td>0.01</td>
<td>120.0</td>
</tr>
<tr>
<td>MALE</td>
<td>0.95</td>
<td>0.21</td>
<td>0.00</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Number of observations, N = 504.

### TABLE 9: LOGIT PARAMETER ESTIMATES (KNEQIP)

<table>
<thead>
<tr>
<th>KNEQIP=1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>LOWNED</td>
</tr>
<tr>
<td>NRCS</td>
</tr>
<tr>
<td>FARMSTRM</td>
</tr>
<tr>
<td>HELA</td>
</tr>
<tr>
<td>HS</td>
</tr>
<tr>
<td>PBEFINC</td>
</tr>
<tr>
<td>DIVERSE</td>
</tr>
<tr>
<td>LCES</td>
</tr>
<tr>
<td>NFARMAC</td>
</tr>
<tr>
<td>NAGE</td>
</tr>
<tr>
<td>MALE</td>
</tr>
</tbody>
</table>

β: Coefficient estimate.  
Pseudo R^2: 0.14  
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 9 provides the parameter estimates for the probability of being aware of EQIP. Results do not indicate that the portion of acres owned by a cattle farmer influences awareness of EQIP. The probability of a farmer being aware of EQIP increases by 0.39 for those who have had contact with NRCS at least 4 times relative to those who have not (P-value < 0.05).

4.3.1.1 Knowledge of EQIP

The distance between a stream and a cattle farm, age of a farmer, the holding of a high school diploma and percentage of income from beef were not found to influence knowledge of the EQIP. An increase in one additional enterprise run by a farmer (besides the beef cattle operation) increased the probability of his awareness of EQIP by 0.05, and had a significant effect on the farmer’s awareness of EQIP at the 0.1 significant level (P-value < 0.10).

The probability of a farmer being aware of EQIP increases by 0.25 if the farmer had four or more contacts with LCES personnel in the year 2002 (P-value < 0.05).

If a farm has been declared “highly erodible” by NRCS, the probability of the farmer being aware of EQIP increases by 0.35, significant at the 0.01 level. A 100-acre increase in the total acres of land used in the cattle operation increases the probability of a farmer being aware of EQIP by 0.02 (P-value < 0.05). MALE was not found to influence awareness of the EQIP.

In summary, the explanatory variables that were significant for the model KNEQIP were NRCS, DIVERSE, LCES, HELA and NFARMAC. This indicates that farmers who are more likely to be aware of EQIP are those who met with NRCS and /or LCES agents four or more times in the year 2002, diversified farmers, farmers whose lands have been declared “highly erodible” by NRCS, and farmers operating larger beef cattle farms. All signs on significant variables are as expected.
TABLE 10: THE PREDICTED AND ACTUAL NUMBERS OF FARMERS AWARE OF EQIP

<table>
<thead>
<tr>
<th></th>
<th>Predicted</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>181</td>
<td>39</td>
<td>220</td>
</tr>
<tr>
<td>1</td>
<td>120</td>
<td>108</td>
<td>228</td>
</tr>
<tr>
<td>Total</td>
<td>301</td>
<td>147</td>
<td>448</td>
</tr>
</tbody>
</table>

Table 10 displays the predicted and actual results of the number of farmers aware of EQIP. Awareness is represented by the number, 1, and non-awareness is represented by the number, 0. The actual 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 was 64.5%

4.3.1.2 Application for EQIP Funds

Table 11 gives a brief description of the descriptive statistics for farmers who had knowledge of EQIP, used in APEQIP. With the exception of the number of observations being reduced from 504 to 228, the means and standard deviations did not change greatly. It can be observed from the table that farmers having knowledge of EQIP operated beef cattle farms on land sizes that ranged from a minimum of 3 acres to a maximum of 12,000 acres and, on average, owned larger portions of their farmland (0.7). Most (88%) held a high school diploma, and 74% had streams flowing less than a mile from their farms.

The parameter estimates for the model APEQIP are summarized in Table 12. The variable LOWNED was not found to significantly affect farmers’ application to EQIP, as suggested by the t-statistic (P-value > 0.10). The probability of a farmer applying for EQIP funds increases by 0.39 if the farmer had contact with NRCS at least 4 times in 2002 (P-value < 0.01). Stream
flowing through a farm decreases the probability of a farmer applying to EQIP by 0.16. Age of a farmer did not significantly influence application for EQIP funds. Unexpectedly, the holding of a

TABLE 11: DESCRIPTIVE STATISTICS (APEQIP)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWNED</td>
<td>0.68</td>
<td>0.38</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NRCS</td>
<td>0.16</td>
<td>0.36</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>0.74</td>
<td>0.44</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NAGE</td>
<td>5.83</td>
<td>1.22</td>
<td>2.70</td>
<td>8.5</td>
</tr>
<tr>
<td>HS</td>
<td>0.88</td>
<td>0.32</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>1.34</td>
<td>0.89</td>
<td>0.00</td>
<td>5.0</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>1.24</td>
<td>1.11</td>
<td>0.00</td>
<td>6.0</td>
</tr>
<tr>
<td>LCES</td>
<td>0.21</td>
<td>0.41</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>HEŁA</td>
<td>0.09</td>
<td>0.29</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>4.92</td>
<td>9.70</td>
<td>0.03</td>
<td>120.0</td>
</tr>
</tbody>
</table>

Number of observations, N = 228.

TABLE 12: LOGIT PARAMETER ESTIMATES (APEQIP)

<table>
<thead>
<tr>
<th>Variable</th>
<th>β</th>
<th>ME</th>
<th>S. Error</th>
<th>t-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.1948</td>
<td>0.5367</td>
<td>0.2614</td>
<td>2.053**</td>
</tr>
<tr>
<td>LOWNED</td>
<td>-0.2560</td>
<td>-0.0626</td>
<td>0.1058</td>
<td>-0.592</td>
</tr>
<tr>
<td>NRCS</td>
<td>2.0310</td>
<td>0.3867</td>
<td>0.0677</td>
<td>5.707**</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>-0.6495</td>
<td>-0.1584</td>
<td>0.0728</td>
<td>-2.174**</td>
</tr>
<tr>
<td>HEŁA</td>
<td>0.9214</td>
<td>0.2034</td>
<td>0.1063</td>
<td>1.913**</td>
</tr>
<tr>
<td>HS</td>
<td>-1.1145</td>
<td>-0.2390</td>
<td>0.0952</td>
<td>-2.510**</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>-0.4587</td>
<td>-0.1122</td>
<td>0.0579</td>
<td>-1.938**</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>0.0853</td>
<td>0.0208</td>
<td>0.0345</td>
<td>0.604</td>
</tr>
<tr>
<td>LCES</td>
<td>0.1916</td>
<td>0.0470</td>
<td>0.0766</td>
<td>0.614</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>0.0102</td>
<td>0.0025</td>
<td>0.0044</td>
<td>0.567</td>
</tr>
<tr>
<td>NAGE</td>
<td>-0.0892</td>
<td>-0.0218</td>
<td>0.0309</td>
<td>-0.707</td>
</tr>
</tbody>
</table>

β: Coefficient estimate  pseudo R²:0.12
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)
high school diploma decreased the probability of a farmer applying to EQIP by 0.24 (P-value < 0.05). Surprisingly, a 20% increase in the percentage of net household income from beef production decreased the probability of a farmer applying to EQIP by 0.11 (P-value < 0.05). The numbers of enterprises run by a farmer apart from beef cattle operation and the number of times a farmer was in contact with LCES officials were not found to be significant.

If a farm had been declared “highly erodible” by NRCS, this increased the probability of the farmer applying by 0.20 (P-value< 0.05). A 100-acre increase in the size of a beef cattle operation was not found to influence application to the EQIP. The probability of a farmer with a stream flowing through his farm, applying to EQIP, decreases by 0.16 at the 0.05 significant level.

In summary, the explanatory variables that turned out significant for the model APEQIP were NRCS, HS, PBEEFINC, HELA and FARMSTRM, indicating that farmers more likely to apply to EQIP are those who have met with NRCS officials four or more times in the year 2002; who do not hold a high school diploma, who have a greater percentage of their net household income coming from beef production, whose lands have been declared “highly erodible” by NRCS, and do not have a stream running through the farm.

### TABLE 13: THE PREDICTED AND ACTUAL NUMBERS OF FARMERS WHO APPLIED TO EQIP

<table>
<thead>
<tr>
<th>Actual</th>
<th>Predicted</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>67</td>
<td>32</td>
<td>99</td>
</tr>
<tr>
<td>1</td>
<td>48</td>
<td>77</td>
<td></td>
<td>125</td>
</tr>
<tr>
<td>Total</td>
<td>115</td>
<td>109</td>
<td></td>
<td>224</td>
</tr>
</tbody>
</table>
### TABLE 14: DESCRIPTIVE STATISTICS (PEQIP)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWNED</td>
<td>0.67</td>
<td>0.36</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NRCS</td>
<td>0.23</td>
<td>0.42</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>RSTRM</td>
<td>0.72</td>
<td>0.45</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NAGE</td>
<td>5.85</td>
<td>1.22</td>
<td>2.70</td>
<td>8.5</td>
</tr>
<tr>
<td>HS</td>
<td>0.85</td>
<td>0.36</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>PBEFINC</td>
<td>1.29</td>
<td>0.84</td>
<td>0.00</td>
<td>5.0</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>1.25</td>
<td>1.14</td>
<td>0.00</td>
<td>6.0</td>
</tr>
<tr>
<td>LCES</td>
<td>0.25</td>
<td>0.43</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>HELA</td>
<td>0.12</td>
<td>0.33</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>4.94</td>
<td>6.78</td>
<td>0.16</td>
<td>50.0</td>
</tr>
<tr>
<td>MALE</td>
<td>0.95</td>
<td>0.21</td>
<td>0.00</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Number of observations, \( N = 224 \).

### TABLE 15: LOGIT PARAMETER ESTIMATES (PEQIP)

<table>
<thead>
<tr>
<th>PEQIP=1</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \beta )</td>
<td>ME</td>
<td>S. Error</td>
<td>t-stat</td>
</tr>
<tr>
<td>Constant</td>
<td>0.4134</td>
<td>0.0887</td>
<td>0.2745</td>
<td>0.323</td>
</tr>
<tr>
<td>LOWNED</td>
<td>0.4044</td>
<td>0.0867</td>
<td>0.1223</td>
<td>0.709</td>
</tr>
<tr>
<td>NRCS</td>
<td>0.7696</td>
<td>0.1506</td>
<td>0.0914</td>
<td>1.648*</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>-0.4571</td>
<td>-0.0997</td>
<td>0.0893</td>
<td>-1.117</td>
</tr>
<tr>
<td>HELA</td>
<td>-0.0765</td>
<td>-0.0166</td>
<td>0.1283</td>
<td>-0.129</td>
</tr>
<tr>
<td>HS</td>
<td>0.3048</td>
<td>0.0677</td>
<td>0.1228</td>
<td>0.551</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>0.7376</td>
<td>0.1582</td>
<td>0.0877</td>
<td>1.804*</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>-0.1942</td>
<td>-0.0416</td>
<td>0.0404</td>
<td>-1.030</td>
</tr>
<tr>
<td>LCES</td>
<td>0.4907</td>
<td>0.1077</td>
<td>0.0912</td>
<td>1.181</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>-0.0588</td>
<td>-0.0126</td>
<td>0.0078</td>
<td>-1.612*</td>
</tr>
<tr>
<td>NAGE</td>
<td>-0.1436</td>
<td>-0.0308</td>
<td>0.0353</td>
<td>-0.871</td>
</tr>
</tbody>
</table>

\( \beta \): Coefficient estimate  
S. error: standard error  
ME: marginal effect  
t-stat: t-statistic.  
t-critical: 0.05** level =1.860, 0.10 level = 1.397  
(Source: generated using the SAS function TINV)
Table 13 gives the predicted and actual results of the numbers of farmers who applied (1) and who did not apply for EQIP (0). Of the 228 farmers having knowledge of EQIP, 43% had not applied to EQIP and 55% had applied to the program. The percentage correctly predicted was 64.30%.

4.3.1.3 Receipt of Payment Under EQIP

The descriptive statistics for farmers who applied to EQIP is given in Table 14. It involves the 224 farmers who applied to the program.

The portions are not greatly different from the overall sample, though one notices that these individuals were more likely to have had contact with the NRCS, to be more diversified, to have had contact with LCES, to have highly erodible land, and to have larger farm acreages.

The parameter estimates for the model PEQIP for each explanatory variable are displayed in Table 15. Results show that NRCS, PBEEFINC and NFARMAC were the only variables found to be significant at the 0.10 level.

The probability of a farmer receiving EQIP funds increases by 0.15 if the farmer had contact with NRCS at least 4 times in 2002. An increase in the percentage of net household income coming from beef production increased the probability of a farmer receiving EQIP funds. The probability of a farmer receiving EQIP funds decreased if the farmer operated a larger farm.

| TABLE 16: THE PREDICTED AND ACTUAL NUMBERS OF FARMERS WHO RECEIVED PAYMENT UNDER EQIP |
|-----------------------------------------------|----------------|
| Actual | Predicted | Total |
| 0      | 11        | 33    |
| 1      | 6         | 88    |
| Total  | 17        | 121   | 138   |
### TABLE 17: DESCRIPTIVE STATISTICS OF CNEQIP

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWNED</td>
<td>0.71</td>
<td>0.34</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NRCS</td>
<td>0.28</td>
<td>0.45</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>0.75</td>
<td>0.44</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>AGE</td>
<td>5.77</td>
<td>1.17</td>
<td>2.90</td>
<td>8.4</td>
</tr>
<tr>
<td>HS</td>
<td>0.87</td>
<td>0.34</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>1.25</td>
<td>0.73</td>
<td>0.00</td>
<td>5.0</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>1.22</td>
<td>1.02</td>
<td>0.00</td>
<td>4.0</td>
</tr>
<tr>
<td>LCES</td>
<td>0.25</td>
<td>0.44</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>HELA</td>
<td>0.13</td>
<td>0.34</td>
<td>0.00</td>
<td>1.0</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>4.39</td>
<td>6.74</td>
<td>0.16</td>
<td>50.0</td>
</tr>
</tbody>
</table>

Number of observations, N = 138.

### TABLE 18: LOGIT PARAMETER ESTIMATES (CNEQIP)

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>ME</th>
<th>S. Error</th>
<th>t-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.1145</td>
<td>-0.0045</td>
<td>0.1827</td>
<td>-0.025</td>
</tr>
<tr>
<td>LOWNED</td>
<td>0.5141</td>
<td>0.0203</td>
<td>0.0525</td>
<td>0.387</td>
</tr>
<tr>
<td>NRCS</td>
<td>0.3886</td>
<td>0.0167</td>
<td>0.0442</td>
<td>0.378</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>0.5590</td>
<td>0.0024</td>
<td>0.0420</td>
<td>0.572</td>
</tr>
<tr>
<td>HELA</td>
<td>0.5462</td>
<td>0.0267</td>
<td>0.0868</td>
<td>0.308</td>
</tr>
<tr>
<td>HS</td>
<td>1.0310</td>
<td>0.0309</td>
<td>0.0399</td>
<td>0.774</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>-1.9549</td>
<td>-0.0774</td>
<td>0.1038</td>
<td>-0.745</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>-0.4677</td>
<td>-0.0185</td>
<td>0.0265</td>
<td>-0.698</td>
</tr>
<tr>
<td>LCES</td>
<td>-0.2660</td>
<td>-0.0109</td>
<td>0.0356</td>
<td>-0.308</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>-0.3608</td>
<td>-0.0143</td>
<td>0.0107</td>
<td>-1.328</td>
</tr>
<tr>
<td>NAGE</td>
<td>-0.0570</td>
<td>-0.0023</td>
<td>0.0142</td>
<td>-0.158</td>
</tr>
</tbody>
</table>

$\beta$: Coefficient estimate  
ME: marginal effect  
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)
From Table 16, the actual results indicated that 32% of farmers in Louisiana applying for EQIP did not receive EQIP funds, while 68% of them did. Percentage correctly predicted was 71.7%, in spite of the general lack of significance of explanatory variables.

4.3.1.4 Cancellation of EQIP

Table 17 gives a brief description of the descriptive statistics for farmers who have been accepted to EQIP, involving the 138 farmers who had received EQIP funding.

Table 18 gives the parameter estimates for the model, CNEQIP, for each explanatory variable. None of the estimates were significant, suggesting that none of the variables significantly affected the choice made by farmers to cancel an EQIP contract.

It can be observed from Table 19 that, of the 85 farmers who received EQIP funding, 82% did not cancel the program and 9% cancelled EQIP after being accepted to the program.

**TABLE 19: NUMBER OF FARMERS WHO CANCELLED EQIP**

<table>
<thead>
<tr>
<th>Actual</th>
<th>Predicted</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>0</td>
<td>77</td>
<td>0</td>
<td></td>
<td>77</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>0</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>0</td>
<td></td>
<td>85</td>
</tr>
</tbody>
</table>

The pseudo R-square values indicate the models’ 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.
4.4 SEQUENTIAL MODEL RESULTS

4.4.1 Sequential Response Model

Tables 20 to 24 display the sequential model results. The sequential model consists of five equations: $\text{EQIP}_0$ is the equation that represents the probability that farmers have no knowledge of EQIP and is equivalent to the logit model, $\text{KNEQIP}=0$. $\text{EQIP}_1$ represents the probability that farmers have knowledge of EQIP but do not apply for EQIP funds and is equivalent to the combination of the logit models: $(\text{KNEQIP}=1, \text{APEQIP}=0)$. $\text{EQIP}_2$ represents the probability that farmers have knowledge of EQIP, applied for funds, but did not receive payment and is equivalent to the combination of the logit models: $(\text{KNEQIP}=1, \text{APEQIP}=1, \text{PEQIP}=0)$. $\text{EQIP}_3$ represents the probability that farmers have knowledge of EQIP, applied for funds, received payment, and did not cancel the EQIP contract later which is equivalent to the logit model combinations: $(\text{KNEQIP}=1, \text{APEQIP}=1, \text{PEQIP}=1, \text{CNEQIP}=0)$. The final equation, $\text{EQIP}_4$, represents the probability that farmers have knowledge of EQIP, applied for funds, received payments, but canceled the contract later, and is also equivalent to the logit model combinations: $(\text{KNEQIP}=1, \text{APEQIP}=1, \text{PEQIP}=1, \text{CNEQIP}=1)$. The results being reported are the marginal effects, ME.

4.4.1.1 Probability of Farmers Having No Knowledge of EQIP

Table 20 gives a description of the parameter estimates for the sequential response model $\text{EQIP}_0 = (\text{KNEQIP}=0)$. Of the eleven explanatory variables used in the equation, five of them were found to be significant at the 0.05 and 0.10 significance levels. These variables were NRCS, DIVERSE, LCES, HELA and NFARMAC. A unit increase in each of these variables resulted in 0.45 (P-value < 0.05), 0.05 (P-value < 0.10), 0.26 (P-value < 0.05), 0.40 (P-value <
# Table 20: Sequential Parameter Estimates (EQIP<sub>0</sub>)

<table>
<thead>
<tr>
<th>Variable</th>
<th>ME&lt;sub&gt;0&lt;/sub&gt;</th>
<th>S. error&lt;sub&gt;0&lt;/sub&gt;</th>
<th>t-stat&lt;sub&gt;0&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.5393</td>
<td>0.2152</td>
<td>2.5056**</td>
</tr>
<tr>
<td>LOWNED</td>
<td>-0.0706</td>
<td>0.0756</td>
<td>-0.9338</td>
</tr>
<tr>
<td>NRCS</td>
<td>-0.4544</td>
<td>0.0771</td>
<td>-5.8936**</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>0.0098</td>
<td>0.0549</td>
<td>0.1793</td>
</tr>
<tr>
<td>HEla</td>
<td>-0.3972</td>
<td>0.0527</td>
<td>-7.5421**</td>
</tr>
<tr>
<td>HS</td>
<td>-0.0238</td>
<td>0.0874</td>
<td>-0.2722</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>-0.0196</td>
<td>0.0413</td>
<td>-0.4745</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>-0.0540</td>
<td>0.0282</td>
<td>-1.9195**</td>
</tr>
<tr>
<td>LCES</td>
<td>-0.2563</td>
<td>0.0497</td>
<td>-5.1543**</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>-0.0139</td>
<td>0.0074</td>
<td>-1.8849**</td>
</tr>
<tr>
<td>NAGE</td>
<td>-0.0042</td>
<td>0.0221</td>
<td>-0.1908</td>
</tr>
<tr>
<td>MALE</td>
<td>-0.1259</td>
<td>0.1164</td>
<td>-1.0824</td>
</tr>
</tbody>
</table>

ME: marginal effect  
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 21: Sequential Parameter Estimates (EQIP<sub>1</sub>)

<table>
<thead>
<tr>
<th>Variable</th>
<th>ME&lt;sub&gt;1&lt;/sub&gt;</th>
<th>S. error&lt;sub&gt;1&lt;/sub&gt;</th>
<th>t-stat&lt;sub&gt;1&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.0326</td>
<td>0.2152</td>
<td>-0.1510</td>
</tr>
<tr>
<td>LOWNED</td>
<td>0.0083</td>
<td>0.0756</td>
<td>0.1091</td>
</tr>
<tr>
<td>NRCS</td>
<td>-0.1353</td>
<td>0.0771</td>
<td>-1.7540**</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>-0.0672</td>
<td>0.0549</td>
<td>-1.2250</td>
</tr>
<tr>
<td>HEla</td>
<td>-0.1340</td>
<td>0.0527</td>
<td>-2.5450**</td>
</tr>
<tr>
<td>HS</td>
<td>-0.1262</td>
<td>0.0874</td>
<td>-1.4430*</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>-0.0470</td>
<td>0.0413</td>
<td>-1.1370</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>0.0421</td>
<td>0.0282</td>
<td>1.4948*</td>
</tr>
<tr>
<td>LCES</td>
<td>-0.0991</td>
<td>0.0497</td>
<td>-1.9930**</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>0.0093</td>
<td>0.0074</td>
<td>1.2654</td>
</tr>
<tr>
<td>NAGE</td>
<td>-0.0089</td>
<td>0.0221</td>
<td>-0.4040</td>
</tr>
<tr>
<td>MALE</td>
<td>-0.0400</td>
<td>0.1163</td>
<td>-0.3440</td>
</tr>
</tbody>
</table>

ME: marginal effect  
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)
0.05) and 0.01 (P-value < 0.05) decreases in the variables, respectively, as all other variables are held constant. These results are consistent in sign with those in Table 9, with slight differences in marginal effects due to their recalculation in the spreadsheet, consistent with the calculation of EQIP₁… EQIP₄.

The results, thus, 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.

4.4.1.2 Probability of Farmers Having Knowledge of EQIP but Not Applying

Five of the explanatory variables in the sequential model equation, EQIP₁ ≈ (KNEQIP=1, APEQIP=0) (Table 22), were found to be significant at the 0.10 significance level. These variables included NRCS, HS, HELA, DIVERSE and LCES. The marginal effects suggests that a unit increase in these variables resulted in a decrease in the probability of a farmer having knowledge of EQIP but not applying to it by 0.14, 0.13, 0.13, 0.04 and 0.10, respectively, holding all other variables constant.

This finding suggests that male farmers who have had contact with NRCS 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. All signs on significant variables were as expected.
4.4.1.3 Probability of Farmers Having Knowledge of EQIP, Applying but Not Receiving EQIP Funding

TABLE 22: SEQUENTIAL PARAMETER ESTIMATES (EQIP$_2$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>ME2</th>
<th>S. error2</th>
<th>t-stat2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.0554</td>
<td>0.3875</td>
<td>-0.1430</td>
</tr>
<tr>
<td>LOWNED</td>
<td>-0.0163</td>
<td>0.1139</td>
<td>-0.1430</td>
</tr>
<tr>
<td>NRCS</td>
<td>-0.1414</td>
<td>0.0654</td>
<td>-2.1610**</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>0.0289</td>
<td>0.0758</td>
<td>0.3811</td>
</tr>
<tr>
<td>HELA</td>
<td>-0.0126</td>
<td>0.0757</td>
<td>-0.1670</td>
</tr>
<tr>
<td>HS</td>
<td>0.0819</td>
<td>0.1009</td>
<td>0.8113</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>0.0021</td>
<td>0.0582</td>
<td>0.0368</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>-0.0151</td>
<td>0.0371</td>
<td>-0.4070</td>
</tr>
<tr>
<td>LCES</td>
<td>-0.0710</td>
<td>0.0794</td>
<td>-0.8950</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>-0.0024</td>
<td>0.0046</td>
<td>-0.5270</td>
</tr>
<tr>
<td>NAGE</td>
<td>0.0133</td>
<td>0.0339</td>
<td>0.3923</td>
</tr>
</tbody>
</table>

ME: marginal effect  
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)

The results obtained for the marginal effect of the equation, EQIP$_2$ $\cong$ (KNEQIP=1, APEQIP=1, PEQIP=0) (Table 22), showed one explanatory variable being significant at the 0.05 level of significance: NRCS. The results suggested that a unit increase in this variable decreased the probability of a farmer having knowledge of EQIP, applying to the program, but not receiving EQIP funding.

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

Table 23 gives the marginal effects for the independent variables for the sequential model equation, EQIP$_3$ $\cong$ (KNEQIP=1, APEQIP=1, PEQIP=1, CNEQIP=0). However, none of the variables were found to be significant.
TABLE 23: SEQUENTIAL PARAMETER ESTIMATES (EQIP3)

<table>
<thead>
<tr>
<th>Variable</th>
<th>ME3</th>
<th>S. error3</th>
<th>t-stat3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-7.33E-06</td>
<td>0.275584</td>
<td>-0.0000</td>
</tr>
<tr>
<td>LOWNED</td>
<td>-1.59E-05</td>
<td>0.119405</td>
<td>-0.0001</td>
</tr>
<tr>
<td>NRCS</td>
<td>-1.39E-03</td>
<td>0.085762</td>
<td>-0.0160</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>2.73E-05</td>
<td>0.090734</td>
<td>0.0003</td>
</tr>
<tr>
<td>HE LA</td>
<td>-1.00E-03</td>
<td>0.082211</td>
<td>-0.0120</td>
</tr>
<tr>
<td>HS</td>
<td>1.07E-03</td>
<td>0.118758</td>
<td>0.0090</td>
</tr>
<tr>
<td>PBEFFINC</td>
<td>4.15E-05</td>
<td>0.092729</td>
<td>0.0004</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>9.33E-06</td>
<td>0.042197</td>
<td>0.0002</td>
</tr>
<tr>
<td>LCES</td>
<td>-3.88E-03</td>
<td>0.090267</td>
<td>-0.0430</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>8.13E-06</td>
<td>0.007731</td>
<td>0.0011</td>
</tr>
<tr>
<td>NAGE</td>
<td>3.88E-06</td>
<td>0.034605</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

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)

4.4.1.5 Probability of Farmers Having Knowledge of EQIP, Applying, Receiving Payment but Canceling EQIP Later

Table 24 gives the marginal effects for the independent variables for the sequential model equation \( EQIP_4 = (KNEQIP=1, APEQIP=1, PEQIP=1, CNEQIP=1) \). However, none of the variables were found to be significant.

The estimated probabilities for the sequential model (table 25) indicate that, of the 504 cattle farmers who completed the survey questionnaire, the probability of a farmer having no knowledge of EQIP (EQIP0) was 0.481; the probability of a farmer having knowledge of EQIP, but not applying to the program (EQIP1) was 0.298; the probability of a farmer having knowledge of EQIP, applying to the program but not receiving payment (EQIP2) was 0.152; the probability of a farmer having knowledge of EQIP, applying to the program, receiving payment and not canceling the program later (EQIP3) was 0.003; and the probability of a farmer having
knowledge of EQIP, applying to the program, receiving payment and canceling the program later (EQIP₄) was 0.066.

**TABLE 24: SEQUENTIAL PARAMETER ESTIMATES (EQIP₄)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>ME⁴</th>
<th>S. error⁴</th>
<th>t-stat⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.0278</td>
<td>1563.6490</td>
<td>-0.000020</td>
</tr>
<tr>
<td>LOWNED</td>
<td>-0.0118</td>
<td>71.8516</td>
<td>-0.000200</td>
</tr>
<tr>
<td>NRCS</td>
<td>-0.0515</td>
<td>63.4695</td>
<td>-0.000800</td>
</tr>
<tr>
<td>FARMSTRM</td>
<td>0.0448</td>
<td>42.1528</td>
<td>0.001100</td>
</tr>
<tr>
<td>HELA</td>
<td>-0.0435</td>
<td>58.4054</td>
<td>-0.000700</td>
</tr>
<tr>
<td>HS</td>
<td>0.0195</td>
<td>58.2024</td>
<td>0.000300</td>
</tr>
<tr>
<td>PBEEFINC</td>
<td>-0.0084</td>
<td>1699.4490</td>
<td>-0.000005</td>
</tr>
<tr>
<td>DIVERSE</td>
<td>-0.0037</td>
<td>31.8566</td>
<td>-0.000100</td>
</tr>
<tr>
<td>LCES</td>
<td>-0.0725</td>
<td>19.8034</td>
<td>-0.004000</td>
</tr>
<tr>
<td>NFARMAC</td>
<td>-0.0002</td>
<td>26.0608</td>
<td>-0.000009</td>
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<td>NAGE</td>
<td>0.0072</td>
<td>9.0881</td>
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ME: marginal effect  
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 25: THE ESTIMATED PROBABILITY VALUES FOR THE SEQUENTIAL MODELS**

<table>
<thead>
<tr>
<th></th>
<th>EQIP0</th>
<th>EQIP1</th>
<th>EQIP2</th>
<th>EQIP3</th>
<th>EQIP4</th>
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<tr>
<td>Probability</td>
<td>0.481</td>
<td>0.298</td>
<td>0.152</td>
<td>0.003</td>
<td>0.066</td>
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</table>
4.5 DISCUSSION

4.5.1 Comparing the Estimated Probability Results of the Logit and Sequential Models and with Results of Other Studies

Comparing variables that were found to be significant for the sequential and non-sequential models, NRCS, DIVERSE, LCES, HELA (Rahelizatovo and Gillespie; Kim et al.) and NFARMAC (Cooper and Keim), were found to be significant for both KNEQIP and EQIP₀ models indicating that a unit increase in the number of times a farmer comes in contact with natural resource conservation service officials and/or Louisiana corporative extension services, diversification, the number of farmlands declared “highly erodible” and the size of cattle operations, results in an increase in the probability of a cattle farmer in Louisiana being aware of EQIP and thus subsequently adopting BMPs. Also, the results obtained for the model EQIP₀ was not surprising since 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.

NRCS, HS, PBEEFINC and HELA were found to be significant for both models APEQIP and EQIP₁, indicating that a unit increase in the number of farmers who have had contact with NRCS at least 4 times in 2002, the amount of farmlands declared “highly erodible”, the percentage of net household income that comes from beef production, would result in an increase in the probability of a farmer applying to the EQIP program and subsequent in adopting BMPs. However, the variable HS had opposing signs, indicating for the logit model that farmers that hold high school diploma are less likely to apply to EQIP, while the sequential model suggests that farmers that have knowledge of EQIP and are holders of high school diploma are more likely to apply for EQIP funding. The sequential result is consistent with Katchova and Miranda 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.

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. NRCS was found to be significant in the EQIP$_2$ model, indicating that farmers who had contact with NRCS at least 4 times in 2002 were more likely to receive EQIP funding.

Ersado et al; Key and McBride; and Katchova and Miranda found that male farmers with greater income from their farms were more likely to adopt BMPs. The results of these studies, however, did not determine whether these groups of farmers were more likely to be accepted under conservation programs such as the EQIP.

Generally, variables that significantly affect farmer’s awareness of EQIP and their decision to adopt BMPs were the number of times farmers met with NRCS officials, high school diploma
holders, and diversification, whether the farmers land had been declared highly erodible by NRCS, and gender.

Variables that were considered important in the study a priori, NAGE 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.
CHAPTER 5
SUMMARY AND CONCLUSION

In an attempt to control degradation of the environment caused by farming, conservation programs have been put in place, one of which is the Environmental Quality Incentives Program (EQIP). The EQIP was established in the 1996 Farm Bill, involving the payment of government subsidies to landowners willing to implement specific cost-intensive conservation practices. The aim of this study is to determine, using logit and sequential models, the awareness of EQIP and subsequent adoption of best management practices (BMPs) by cattle farmers in Louisiana.

Results of the logit models indicate that farmers who are more likely to be aware of EQIP are those who have met with NRCS and/or LCES agents four or more times in the year 2002, diversified farmers, farmers whose lands have been declared “highly erodible” by NRCS, and farmers operating larger beef cattle farms. Farmers more likely to apply to EQIP are those who have met with NRCS officials four or more times in the year 2002, who do not hold high school diploma, who have lower percentages of their net household income coming from beef production, whose lands have been declared “highly erodible” by NRCS, and males.

Farmers who are more likely to receive EQIP funding are farmers who have had contact with NRCS officials at least 4 times in 2002. None of the estimates were significant for the CNEQIP equation, suggesting that none of the variables significantly affected the decision of farmers to cancel EQIP contracts later.

Results of the sequential model indicated 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 4 times in 2002, are diversified, whose farms have been declared “highly erodible” by NRCS and for farmers who operate beef cattle farms on larger acreages of land. Of the farmers who knew of EQIP, those who had contact with NRCS officials at least 4 times in 2002, were
holders of high school diploma, whose farms had been declared “highly erodible” by NRCS were less likely to have not applied to EQIP. Farmers who had contact with NRCS at least 4 times in the year 2002 and whose land had been declared “highly erodible” by NRCS were less likely to receive EQIP funding. Finally, the sequential model results also suggest that an increase in the number of times a farmer had contact with NRCS decreased the probability of a farmer later canceling the contract.

The estimated probabilities for the logit model indicate that, of the 504 cattle farmers who completed the survey questionnaire, 49% had no knowledge of EQIP and 51% had knowledge of EQIP. For the 228 farmers who had knowledge of EQIP, 43% did not apply to EQIP and 55% applied to the program. Results indicated that 32% of farmers received EQIP funding while 68% did not. Of the 85 farmers who received funds under EQIP, 82% did not cancel the program and 9% cancelled after being accepted to the program. The sequential analysis results indicate that the 49% of farmers in Louisiana had no knowledge of EQIP. The percentage of farmers having knowledge of EQIP but not applying to the program was 30%. The percentage of farmers having knowledge of EQIP, applying to the program but not receiving payment was 15%. The percentage who had knowledge of EQIP, applied to the program, received payment and did not cancel the program later was 1% and the percentage who had knowledge of EQIP, applied to the program, received payment and later canceled the EQIP contract was 10%.

For both models, results generally indicate that the number of times a farmer comes in contact with NRCS and/or LCES officials, whether he is diversified and the size of his cattle operation affects his awareness, application and eventual adoption of BMPs under EQIP. This is not surprising since NRCS has been given the authority to administer the program. It does suggest that further funding of education by NRCS could 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, the Assistant State Conservationist of NRCS in Louisiana indicated that officials who administer the EQIP went out to inform producers of the conservation provisions of the 2002 Farm Bill and 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.

The closeness of a cattle farm to a stream did not significantly affect farmers’ awareness and eventual adoption of 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.

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 EQIP and were more likely to adopt BMPs. They are also the worse offenders when it comes to manure pollutants (Feinerman et al.). Keeping this group of farmers in the program would put
them in check. They could also help in the funding of the program and also 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 is the best model for this study because it does not exhibit Independence of irrelevance alternatives (IIA) and is an improvement on conditional analysis.

It was expected that results obtained from this study would provide an idea on the number and type of cattle farmers in Louisiana aware of the EQIP program and involved in its activities. It was also hoped that this information would help in the structuring of policies that govern the EQIP and, thus, would further improve conditions in cattle operations and the agricultural sector as a whole. 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.

A limitation associated with this study is that the sequential analysis had to be calculated by hand after obtaining the logit model results, making it tedious and prone to human errors. It is hoped that a program would be developed that can calculate sequential analysis problems more accurately, thus, eliminating errors and also saving time.
REFERENCES


25. Feder, G., R. E. Just and D. Zilberman. “Adoption of Agricultural Innovation in Developing Countries: A survey” World Bank Staff Working Papers, Number 542.


### LOGIT MODELS MAXIMUM LIKELIHOOD ESTIMATES

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<tr>
<th>Dependent variable</th>
<th>Number of obs.(N)</th>
<th>Log likelihood function</th>
<th>Restricted log likelihood</th>
<th>Chi squared</th>
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<th>Prob[ChiSqd &gt; value]</th>
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APPENDIX B

INFORMATION STATISTICS FOR THE DISCRETE CHOICE MODELS

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APPENDIX C

SURVEY QUESTIONNAIRE

(Original survey composed by Seon-Ae Kim and used with her permission in this work.)
Adoption of Conservation Practices by Beef Cattle Producers

A SURVEY

LSU Ag Center
Research & Extension
Section I. Farm Operation

1. Did this farm operation have any beef cattle at any time during 2002? (Mark ☑ one)
   Yes → [Continue with 2.]
   No → [Please return the questionnaire in the envelope provided. Thank you!]

2. In each of the following categories, what is the maximum number of animals you had in 2002?
   - Cows and calving heifers
   - Bulls
   - Replacement heifers
   - Stockers
   - Calves
   - Feeders

3. Under what type of ownership is your beef cattle operation? (Mark ☑ one)
   - Family corporation
   - Non-family corporation
   - Sole proprietorship (including husband/wife partnership)
   - Partnership
   - Other

4. Does your beef operation include: (Mark ☑ all that apply)
   - a cow-calf operation?
   - purebred or seedstock cattle production?
   - a stocker operation?
   - a finishing operation?

5. Please mark any other livestock and/or crops that you raise for sale or feeding. (Mark ☑ all that apply)
   - Corn
   - Oats
   - Broilers
   - Hay
   - Cotton
   - Sugarcane
   - Sheep
   - Vegetable Production
   - Wheat
   - Rice
   - Goats
   - Fruit Production
   - Soybeans
   - Hogs
   - Dairy
   - Forestry

6. How many acres of land are included in your entire farm operation?
   _______________ (acres)

7. How many acres of your farm are exclusively devoted to the beef cattle operation, including pasture, hay and other land that supports the beef cattle operation?
   _______________ (acres)

8. How many acres of land do you use for beef cattle grazing?
   _______________ (acres)

9. Of the land you use for the beef cattle operation, how many acres do you own?
   _______________ (acres)

10. How many years have you been operating a beef cattle farm?
    _______________ (years)

11. How many family members besides yourself work on your farm at least once per week? (Mark ☑ one)
    - 0
    - 1
    - 2
    - 3 or more

12. Are you a member of the Louisiana Cattlemen's Association? (Mark ☑ one)
    - Yes
    - No
13. How many times did you have business contact with Natural Resource Conservation Service (NRCS) in 2002? Please include attending seminars or workshops, and in-person, telephone and e-mail contacts. (Mark one)
   - None
   - 1-3 times
   - 4 times or more

14. How many times did you have business contact with Louisiana Cooperative Extension Service in 2002? Please include attending seminars or workshops, and in-person, telephone and e-mail contacts. (Mark one)
   - None
   - 1-3 times
   - 4 times or more

15. Has any of the land you use for your beef cattle operation been classified as “Highly Erodible” by NRCS? (Mark one)
   - Yes
   - No
   - I don’t know.

16. How far from your beef cattle farm is the nearest stream or river? (Mark one)
   - A stream/river runs through my farm
   - Less than a mile
   - More than a mile

17. How many years do you plan to continue operating your beef cattle farm? ____________ (years)

18. Do any of your children or any other family member plan to take over your beef cattle farm upon your retirement? (Mark one)
   - Yes
   - No
   - I don’t know.

19. Relative to other investors, how would you characterize yourself? (Mark one)
   - I tend to take on substantial levels of risk in my investment decisions.
   - I neither seek nor avoid risk in my investment decisions.
   - I tend to avoid risk when possible in my investment decisions.

20. Please tell us your opinion on the following statements by marking an “%” in the correct category.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Somewhat agree</th>
<th>Undecided</th>
<th>Somewhat disagree</th>
<th>Strongly disagree</th>
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</thead>
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<tr>
<td>Laws regulating excess soil erosion are badly needed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Given the economic realities, soil and water conservation programs are often carried too far.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The government should pay farmers to practice soil and water conservation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The government should not be involved in agriculture at all.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government involvement in agriculture has helped farmers.</td>
<td></td>
<td></td>
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</table>

Section II. Best Management Practices

1. Are you familiar with the term “Best Management Practices” (BMPs)? (Mark one)
   - Yes
   - Not really
BMPs are practices used by farmers to control the delivery of soil, chemical, fertilizer, animal waste and other pollutants from farmland to water resources.

2. 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)? (Mark ☒ one)
   - Yes → [Continue with 2A.]
   - No → [Skip to 3.]

   2A. [If Yes in 2.] Have you ever applied for cost-share payments and/or incentive payments through EQIP for the adoption of one or more BMPs? (Mark ☒ one)
      - Yes → [Continue with 2B.]
      - No → [Skip to 3.]

   2B. [If Yes in 2A.] Did you receive a cost-share payment and/or an incentive payment? (Mark ☒ one)
      - Yes, I received cost-share payments. → [Continue with 2C.]
      - Yes, I received incentive payments. → [Continue with 2C.]
      - Yes, I received both cost-share and incentive payments. → [Continue with 2C.]
      - No, I was not chosen to be a recipient. → [Skip to 3.]
      - I was chosen to be a recipient, but I cancelled before I received any money. → [Skip to 3.]
      - I applied and am waiting for the response. → [Skip to 3.]

   2C. Did you cancel the contract later? (Mark ☒ one)
      - Yes
      - No

Please answer the following questions regarding best management practices for beef cattle production. (Mark only one ☒ for each question.)

3. **Field borders and filter strips**: are strips of grasses or other close-growing vegetation planted around fields and along drainage ways, streams and other water bodies. The main purposes are to reduce sediment, organic material, nutrients and chemicals carried in runoff. Do you use this practice? (Mark ☒ one)
   - Yes — With an incentive payment.
   - Yes — With a cost-share payment.
   - Yes — At my own expense.
   - No — I am not familiar with it.
   - No — It doesn’t apply to my farm.
   - No — It costs too much.
   - No — I am still considering it.
   - No — I prefer not to use it.

4. **Grassed waterways** are natural or constructed channels that are shaped or graded to required dimensions and planted in suitable vegetation to carry water runoff. They are designed to carry runoff without causing erosion or flooding and to improve water quality by filtering out suspended sediments. Do you use this practice? (Mark ☒ one)
   - Yes — With an incentive payment.
   - Yes — With a cost-share payment.
   - Yes — At my own expense.
   - No — I am not familiar with it.
   - No — It doesn’t apply to my farm.
   - No — It costs too much.
   - No — I am still considering it.
   - No — I prefer not to use it.

5. **A fence** is a constructed barrier to prevent, restrict or control use by animals, vehicles or people. This may be applied on areas where livestock or wildlife control is needed such as along waterways, and for use in a grazing system. Do you use this practice? (Mark ☒ one)
   - Yes — With an incentive payment.
   - Yes — With a cost-share payment.
   - Yes — At my own expense.
   - No — I am not familiar with it.
   - No — It doesn’t apply to my farm.
   - No — It costs too much.
   - No — I am still considering it.
   - No — I prefer not to use it.
6. **Heavy use area protection** involves establishing vegetative cover, installing suitable surface materials and constructing needed structures where animals congregate. The main purpose is to stabilize areas frequently and intensively used by animals or vehicles. Do you use this practice? (Mark [ ] one)

   Yes—— [ ] With an incentive payment. [ ] With a cost-share payment. [ ] At my own expense.  
   No ——— [ ] I am not familiar with it. [ ] It doesn’t apply to my farm. [ ] It costs too much. [ ] I am still considering it. [ ] I prefer not to use it.

7. **A water facility (a trough or a tank)** is a watering system installed to provide drinking water for livestock. Do you use this practice? (Mark [ ] one)

   Yes—— [ ] With an incentive payment. [ ] With a cost-share payment. [ ] At my own expense.  
   No ——— [ ] I am not familiar with it. [ ] It doesn’t apply to my farm. [ ] It costs too much. [ ] I am still considering it. [ ] I prefer not to use it.

8. **A cover and green manure crop** is a crop of close-growing grasses, legumes or small grain grown for seasonal soil protection and improvement. It is designed to control erosion during periods when the major crops do not furnish enough cover. It also adds organic material to the soil and improves infiltration capacity, aeration and tilth. Do you use this practice? (Mark [ ] one)

   Yes—— [ ] With an incentive payment. [ ] With a cost-share payment. [ ] At my own expense.  
   No ——— [ ] I am not familiar with it. [ ] It doesn’t apply to my farm. [ ] It costs too much. [ ] I am still considering it. [ ] I prefer not to use it.

9. **Critical area planting** is planting trees, shrubs, vines, grasses or legumes, on highly erodible or critically eroding areas. The purposes are to stabilize the soil, reduce damage from sediment and runoff to downstream areas, and improve wildlife habitat and aesthetics. Do you use this practice? (Mark [ ] one)

   Yes—— [ ] With an incentive payment. [ ] With a cost-share payment. [ ] At my own expense.  
   No ——— [ ] I am not familiar with it. [ ] It doesn’t apply to my farm. [ ] It costs too much. [ ] I am still considering it. [ ] I prefer not to use it.

10. **Regulating water in a drainage system** involves controlling the removal of surface runoff, primarily through the operation of water control structures. The purpose is to conserve surface water by controlling outflow from drainage systems. Do you use this practice? (Mark [ ] one)

    Yes—— [ ] With an incentive payment. [ ] With a cost-share payment. [ ] At my own expense.  
    No ——— [ ] I am not familiar with it. [ ] It doesn’t apply to my farm. [ ] It costs too much. [ ] I am still considering it. [ ] I prefer not to use it.

11. **A riparian forest buffer** is an area of trees, shrubs and other vegetation located adjacent to and uphill from a water body. The main purposes are to (1) create shade to lower temperature, and (2) remove or reduce the effects of nutrients, sediment, organic material and other pollutants before entry into water bodies. Do you use this practice? (Mark [ ] one)

    Yes—— [ ] With an incentive payment. [ ] With a cost-share payment. [ ] At my own expense.  
    No ——— [ ] I am not familiar with it. [ ] It doesn’t apply to my farm. [ ] It costs too much. [ ] I am still considering it. [ ] I prefer not to use it.

12. **Streambank and shoreline protection** involves the use of vegetation or structures to stabilize and protect banks of water bodies against erosion. Do you use this practice? (Mark [ ] one)

    Yes—— [ ] With an incentive payment. [ ] With a cost-share payment. [ ] At my own expense.  
    No ——— [ ] I am not familiar with it. [ ] It doesn’t apply to my farm. [ ] It costs too much. [ ] I am still considering it. [ ] I prefer not to use it.
13. *Livestock exclusion* involves excluding animals from an area to protect, maintain or improve the quantity and quality of the natural resources. Do you use this practice? (Mark one)
   - Yes
   - No
   - With an incentive payment.
   - With a cost-share payment.
   - At my own expense.
   - I am not familiar with it.
   - It doesn't apply to my farm.
   - It costs too much.
   - I am still considering it.
   - I prefer not to use it.

14. *Nutrient management* is a strategy for making use of plant nutrients to enhance productivity while protecting water resources. The recommended practices are soil testing, basing fertilizer and lime applications on soil test results, using animal manures and organic materials, using legumes, controlling nutrient losses through erosion, and rotating crops. Mark “Yes” if you use any of these practices. (Mark one)
   - Yes
   - No
   - With an incentive payment.
   - With a cost-share payment.
   - At my own expense.
   - I am not familiar with it.
   - It doesn't apply to my farm.
   - It costs too much.
   - I am still considering it.
   - I prefer not to use it.

15. *Pesticide management* involves selecting pesticides to give desired results with the least environmental impact. Do you use this practice? (Mark one)
   - Yes
   - No
   - With an incentive payment.
   - With a cost-share payment.
   - At my own expense.
   - I am not familiar with it.
   - It doesn't apply to my farm.
   - It costs too much.
   - I am still considering it.
   - I prefer not to use it.

16. *Mortality management* is proper management of animal carcasses. This involves cremation or deep burial to prevent, control and eradicate contagious or communicable diseases and viruses. Do you use this practice? (Mark one)
   - Yes
   - No
   - With an incentive payment.
   - With a cost-share payment.
   - At my own expense.
   - I am not familiar with it.
   - It doesn't apply to my farm.
   - It costs too much.
   - I am still considering it.
   - I prefer not to use it.

17. *Continuous grazing* is unrestricted grazing of a pasture by livestock throughout a certain season or during the entire year. Controlled stocking is necessary to prevent overgrazing. Do you use this practice? (Mark one)
   - Yes
   - No
   - With an incentive payment.
   - With a cost-share payment.
   - At my own expense.
   - I am not familiar with it.
   - It doesn't apply to my farm.
   - It costs too much.
   - I am still considering it.
   - I prefer not to use it.

18. *Rotational grazing* involves utilizing subdivided paddocks of pasture. For a particular subdivided area, a rest period follows each grazing period. A high stocking rate is imposed on a paddock for a short time. Then, animals are shifted to another paddock. Do you use this practice? (Mark one)
   - Yes
   - No
   - With an incentive payment.
   - With a cost-share payment.
   - At my own expense.
   - I am not familiar with it.
   - It doesn't apply to my farm.
   - It costs too much.
   - I am still considering it.
   - I prefer not to use it.

18A. (If Yes in 18.) Does this rotational grazing system include at least 5 paddocks?
   - Yes
   - No
   - [Continue with 18B.]
   - [Skip to Section III.]

18B. (If Yes in 18A.) How many acres of land do you use for this rotational grazing?
   - _________ (acres) → [Skip to Section IV.]

**Section III. Rotational Grazing Systems**

Since 1996, USDA has assisted farmers in adopting Best Management Practices through EQIP. EQIP provides technical assistance, cost-share payments, and incentive payments to assist farmers with conservation improvements. Currently, through EQIP, the federal government is cost sharing up to 75 percent of the cost, but will cost share 90 percent if the producer is a limited-resource or beginning farmer. The EQIP contract term is 1 to 10 years, and applications are accepted throughout the year. NRCS evaluates each application. Once a farmer is chosen as a recipient,
he or she installs the facility, submits the expenses to NRCS, and is reimbursed according to the contract.

For most beef operations, 5 to 10 fenced paddocks are recommended for rotational grazing. This permits paddocks to be grazed 3 to 7 days and rested 25 to 35 days. Watering facilities are included in each paddock. The key to successful rotational grazing is allowing forages in some pastures to rest and regrow while another pasture is being grazed. Proper grazing is usually measured in terms of forage height. Assuming self-filled metal troughs, ¼ inch pipeline, single strand electric wire, and either a solar panel or energizer we estimate the cost to be about $50 per cow, including labor expenses.

The advantages of rotational grazing include 1) increased carrying capacity, 2) better persistence and productivity of pasture plants, 3) improved utilization of more forage species in the pasture, 4) less forage wasted by trampling, and 5) prevention of soil erosion. The disadvantages of rotational grazing include the investment cost in the beginning and increased management. The top picture on the cover of the survey booklet shows a rotational grazing system.

1. Suppose that the total cost of establishing a rotational grazing system is $50 per cow, including self-filled troughs, electric fencing, pipeline and labor charges for this installation. Suppose the federal government were to agree to pay 80 percent ($40 per cow) of the cost. Would you be willing to pay the remainder ($10 per cow) to adopt it? (Mark one)

   a) I definitely would adopt it. → [Skip to 3A.]
   b) I probably would adopt it. → [Skip to 3A.]
   c) I would slightly lean towards adopting it. → [Skip to 3A.]
   d) I would slightly lean towards not adopting it → [Continue with 2.]
   e) I probably would not adopt it. → [Continue with 2.]
   f) I definitely would not adopt it. → [Continue with 2.]

2. Which of the following best describes your reason(s) for not adopting a rotational grazing system, supposing you would receive a cost share payment for implementing it? (Mark all that apply) (Skip to Section IV after marking.)

- I rent the land for my beef cattle operation.
- I believe rotational grazing is not profitable, even if there is a cost-share payment.
- I do not want to go through the paperwork involved in getting the cost share.
- I believe I have too few animals to be able to practically use a rotational grazing system.
- I prefer not to deal with the additional management and labor required with a rotational grazing system.
- The land I use for beef cattle is not erodible.
- I do not like the way the government pays the cost share payment.
- I need more information on rotational grazing in order to make a decision.
- Other

3A. Which of the following best describes your reason(s) for answering that you would adopt or would consider adopting a rotational grazing system? (Mark all that apply)

- I believe soil and water conservation is very important.
- I believe rotational grazing is a better way of managing grazing land.
- I believe rotational grazing is profitable under these circumstances.
- I was considering implementation of a rotational grazing system before.
- I have heard about the benefits of rotational grazing from farmers, specialists, workshops, magazines, etc.
- I am very concerned about this issue, but I am not sure I could afford to pay this much.
- I wanted to show my support for the government’s funding of EQIP.
- Other

3B. On what percentage of your beef cattle pasture would you likely utilize a rotational grazing system under this cost-share payment? ___________________ (percent)

Section IV. Producer and Farm Characteristics

1. What is your gender? (Mark one)

   Male
2. How old were you on your last birthday? _____________ (years)

3. What is the highest level of education you have completed? (Mark ✗ one)
   - Less than high school
   - High school graduate or GED
   - Some college or technical school
   - College Bachelor’s degree
   - Advanced degree

4. Which of the following best describes your 2002 household net income from all sources? (Mark ✗ one)
   - Less than $30,000
   - $30,000 to $59,999
   - $60,000 to $89,999
   - $90,000 to $119,999
   - More than $120,000

5. Did more than half of your 2002 household net income come from non-farming sources? (Mark ✗ one)
   - Yes
   - No

6. Approximately what percentage of your 2002 household net income came from your beef cattle operation? (Mark ✗ one)
   - 0 percent
   - 1 to 20 percent
   - 21 to 40 percent
   - 41 to 60 percent
   - 61 to 80 percent
   - 81 to 100 percent

7. What is your farm’s current debt/asset ratio? (Mark ✗ one)
   - 0 percent
   - 1 to 20 percent
   - 21 to 40 percent
   - 41 to 60 percent
   - Over 60 percent

8. Do you have an off-farm job or occupation? (Mark ✗ one)

   - Yes → [Continue with 8A.]
   - No → [Skip to 9.]

8A. [If Yes in 8.] How many hours per week do you work off the farm? ____________ (hours per week)

9. How would you describe the land on which your beef cattle are grazed? (Mark ✗ all that apply)
   - Hilly in South LA
   - Hilly in North LA
   - Marsh in South LA
   - Marsh in North LA
   - River bottom in South LA
   - River bottom land in North LA
   - Prairie in South LA
   - Other

Thank You!!!
Please return your completed questionnaire in the enclosed postage paid envelope to: Dr. Jeffrey Gillespie
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Joyce Obubuafo is a Ghanaian by birth. She is the third born of five siblings. She attended and completed her primary, secondary and bachelor educations in Ghana. She did her bachelor’s degree in agricultural education at the University of Winneba, Manpong Ashanti, and completed in 2000. She served as a tutor in the Ghana Education Service during and after completing her bachelor degree. In 2003, she went back to school to further her education in agricultural economics at the Louisiana State University, Baton Rouge and completed a master’s program in May 2006.