THE INFLUENCES OF LAND TENANCY AND ROTATION SELECTION ON CRAWFISH FARMERS' ADOPTION OF BEST MANAGEMENT PRACTICES

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This study investigates factors influencing the adoption of best management practices in Louisiana crawfish production. Probit results show acreage, years farming, portion of income from farming, technology adoption tendencies, hunting leases and a stream running through the farm to influence adoption. The most frequently used BMP was irrigation water management.

Key words: Best Management Practices (BMPs), technology adoption, crawfish, probit, tenancy, crop rotation

United States crawfish production, concentrated primarily in Southern Louisiana, furnishes product to consumers who use it primarily for crawfish boils and other cuisine that is unique to the region. Louisiana has almost 1,200 crawfish farms on more than 120,000 acres (LSU Agricultural Center). Although production in the wild habitat, mainly the Atchafalaya River basin, varies by year, total crawfish production during the 2004-2005 season was more than 82 million pounds (LSU Agricultural Center). Farm-raised and wild catch yields were 74 million and 8 million pounds, respectively.

Agricultural production yields nonpoint pollutants such as nutrients, sediment, pesticides, and others. Most U.S. agricultural nonpoint pollution reduction policies have been designed to induce producers to change production practices in ways that improve the environment and related economic consequences of production. The information necessary to design economically efficient pollution control policies is almost always lacking (Ribaudo, Horan, and Smith). This is the case particularly with nonpoint sources of pollution because of the large number of firms involved and the heterogeneous nature of land. Point sources of pollution were first addressed, but agricultural nonpoint sources have commanded a greater focus in recent years.

Contaminated waters have effects on drinking water supplies, fisheries, recreation, and wildlife (Rahelizatovo). Drain-off water associated with crawfish production, as with any other agricultural enterprise, must be handled and managed in an environmentally suitable and sustainable manner. The Coastal Zone Act Reauthorization Amendment of 1990 (CZARA) states that states participating in the Coastal Zone Management Act submit a Coastal Nonpoint Pollution Control Program (CNPCP) to the Secretary of Commerce and the U.S. Environmental Protection Agency for approval. The program must include "enforceable policies and mechanisms to implement the applicable requirements of the Coastal Nonpoint Pollution Control Program of the state required by section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990" (Henning and Cardona). In addition, states must develop policies and mechanisms to control nonpoint sources of pollution, as required by the Clean Water Act, amended in 1987. Nonpoint source pollution must be addressed according to Section 319, by assessing problems and causes and adopting and implementing management programs. It is a voluntary task to implement the Coastal Nonpoint Pollution Control Program (CNPCP) in Louisiana.

Little is known about the extent of adoption of production practices that reduce nonpoint source pollution in crawfish production, and it is expected that crawfish crop rotation and tenancy, both of which have unique characteristics in Louisiana crawfish production, influence adoption. Most existing research on crawfish production to date has emphasized practices such as pond management, stocking density, time of harvest, etc. We have not identified previous research on the adoption of best management practices in crawfish production.

To address problems associated with water quality, voluntary adoption of a number BMPs is encouraged. The Environmental Protection Agency (EPA) has considered agriculture to be one of the major pollution sources. Agricultural runoff, urban runoff, silviculture, marinas and recreational boating, and canalization and channel modification are considered as five major nonpoint pollution sources (Rahelizatovo).

Significant study has been conducted to understand the extent of adoption of best management practices (BMPs) that are designed to reduce the impacts of agriculture on the environment and improve agricultural sustainability (e.g., Rahelizatovo and Gillespie, Henning and Cardona). Systems of BMPs are considered to be the effective method of controlling agricultural nonpoint source pollution as they have greater impact on all three stages: the source, the transport, and the water body, rather than the use of a single BMP.

The objectives of this study are to assess the extent of current adoption of BMPs in the Louisiana crawfish industry; to determine the effects of rotational, tenancy, demographic, socioeconomic and farm characteristics on crawfish producers' decisions to adopt specific BMPs; and to make policy recommendations based on the empirical results. Eighteen USDA-Natural Resource Conservation Service (NRCS) cost-share eligible BMPs were selected in the study and their extent of adoption was analyzed with respect to factors influencing it.

Previous Research

A number of studies have examined the adoption pattern of new technologies and BMPs in agricultural industries. Several factors such as producer awareness, land tenure, economic incentives and farm characteristics have been shown to influence the rate of BMP adoption (Henning and Cardona; Ipe et al.; Soule, Tegene and Wiebe). Rogers emphasized that the rate of innovation adoption is characterized by five major qualities: perception, compatibility, complexity, feasibility, and visibility. He further divided adopter qualities into five different types: innovators, early adopters, early majority, late majority, and laggard. These qualities were considered in his integrated pest management study where risk perceptions, farm structure, crops grown, and other important factors were hypothesized to affect the adoption decision. Multinomial logit analysis confirmed that adopters were more prone to take risks than non-adopters. Farm size, family labor, and the use of irrigation were positively related to the adoption of integrated pest management. The study further concluded that farm location and the type of crop grown also significantly influenced adoption.

Logan discussed how national awareness of environmental contamination due to agricultural practices dates back to at least 1962, when the role of phosphorus non-point source pollution was regarded to be a significant problem. Several agricultural practices such as the use of fertilizers and pesticides were shown to be major contributors to high nitrate levels in some rivers and water wells. Erosion contributed to sediment contamination in water bodies in agricultural areas. To supplement existing BMPs designed particularly to control soil erosion, he emphasized to the use of an integrated approach in fertilization and pest management.

Factors influencing BMP adoption in Louisiana sugarcane production were examined using a multivariate probit model (Henning and Cardona). Education and cost-sharing programs were concluded to be effective means of increasing adoption rates. They found more than 90 percent adoption of at least one BMP where risk of yield loss was not a factor. Meeting with extension personnel greatly influenced adoption decisions.

Fernandez-Cornejo, Beach, and Huang studied factors affecting the adoption of integrated pest management practices by vegetable growers in Florida, Michigan, and Texas. They discussed how health and environmental hazards of pesticides could be managed using integrated pest management techniques, which combine cultural, biological, and chemical measures to reduce the pest population below a threshold level.

Feather and Amacher investigated the role of information in the adoption of BMPs for water quality improvement. Data from an adoption survey conducted by USDA to evaluate a demonstration project were used. They analyzed how producer perceptions of risk, profitability, and improvements in environmental quality influenced adoption. Results showed that producer perceptions significantly influenced the adoption rate.

Traore, Landry, and Amara examined the roles of perception, environmental quality awareness and farm characteristics in adoption of conservation practices by using survey data of potato farmers in Quebec, Canada. A two-stage model consisted of perception and adoption stages which analyzed the farmer's awareness of environmental degradation and the rate of adoption of conservation practices to overcome the problem. Farmer education level, perception of the environmental problem, expected crop loss to pests and weeds, perceived health effects of farm chemical application, and information were found to be major factors affecting the adoption of BMPs.

The role of BMPs on water quality related to diffuse pollution was studied by D'Arcy and Frost considering management measures to control both urban and rural run-off. Because there was no single point of discharge, the only way to overcome the problem was through the adoption of BMPs. They emphasized effective monitoring strategies on land-use decisions, which have the inevitable pollution consequences to overcome the problem of diffuse pollution.

Gillespie, Kim, and Paudel surveyed cattle producers to investigate rates of adoption and non-adoption of 16 BMPs. The impact of factors was analyzed using a multinomial logit model. The influences of farm type, information sources, input quality, and situational and attitudinal variables on the non-adoption of BMPs were studied. Results showed unfamiliarity and non-applicability to be the most commonly cited reasons for non-adoption. Other reasons included high cost, still considering adoption, and a preference not to adopt.

Data and Methods

The extent of BMP adoption in Louisiana crawfish production is assessed using crawfish producer responses obtained from a mail survey conducted during Fall, 2008, to 770 Louisiana crawfish producers who were on the mailing list for crawfish newsletters sent by the LSU Agricultural Center. Dillman's Total Design Method was used for implementing the survey. The questionnaire was eight pages long including a cover page that included the title, a picture of crawfish being harvested, and no questions.

Producers were asked a variety of questions including general production practice and BMP adoption, tenancy arrangements, participation in the Environmental Quality Incentives Program (EQIP), use of various record-keeping systems, and demographic and general farm information.

The first mailing, in September 2008, included the questionnaire. Each letter was personally addressed and signed and first-class mail was used. This was followed by a postcard reminder approximately 1 ½ weeks later to all who received the survey. A second copy of the survey was then sent to non-responders via first-class mail approximately 1 ½ weeks after the postcard reminder. Finally, a second postcard reminder was sent to all non-responders approximately 1 ½ weeks after the second survey. Thus, four contacts were made to producers. Of the 770 who were sent surveys, 79 were returned as non-deliverable, 185 were sent back the survey stating that they had not produced crawfish during the 2007-2008 production season, and 73 were returned as completed surveys. Thus, the adjusted response rate was 14%.

Adoption of 18 separate BMPs listed in Table 1 was asked with 10 potential choices, only one of which was to be chosen. These choices included: “Yes, I adopted it because it leads to increased profit,” “Yes, I adopted it because it is good for the environment,” “Yes, I adopted it because I have been encouraged / required to do so,” “Yes, I established it because it’s good for long-run land productivity,” “Yes, this practice was established by the landowner or another tenant,” “No, I am not familiar with this practice,” “No, this doesn’t apply to my farm,” “No, this would reduce my profit,” “No, I am still considering doing this,” and “No, I prefer not to do this.”

Logit models were used to analyze the impact of independent variables influencing crawfish producers’ BMP adoption decisions. The likelihood of a crawfish producer of a specific description adopting each BMP was analyzed. Using the logit model, which assumes a logistic distribution, the probability of adoption is modeled as shown in Greene (1):

(1) $$\Pr(Y=1) = \frac{e^{\beta' x}}{1+e^{\beta' x}} = \Lambda(\beta' x)$$

Marginal effects for continuous variables are estimated as:

(2) $$\frac{d\Lambda[\beta' x]}{d(\beta' x)} = \frac{e^{\beta' x}}{(1+e^{\beta' x})^2} = \Lambda(\beta' x)[1-\Lambda(\beta' x)]$$

Marginal effects for dummy variables are estimated as:

(3) $$\Pr[Y=1|\bar{x}_*, d=1] - \Pr[Y=1|\bar{x}_*, d=0]$$

Where $\bar{x}_*$ refers to all other variables held at their mean values.

The BMPs to be analyzed using logit models include those 12 that had been adopted by at least 15% of the respondents. With only 45 to 53 observations being used for each of the runs due to incomplete data, this insured that at least eight producers had adopted the BMP for estimation purposes. All 18 BMPs are defined in Table 1. The 12 for which logit models were estimated include: Conservation Cover, Critical Area Planting, Field Border, Grade Stabilization Structure, Filter Strips, Grassed Waterway, Irrigation Water Management, Irrigation Land Leveling, Irrigation System with Tailwater Recovery, Irrigation Water Conveyance via a Pipeline, Nutrient Management, and Pumping Plant. Those which had <15% adoption rates include Irrigation Storage Reservoir, Irrigation Regulating Reservoir, Range Planting, Riparian Forest Buffer, Streambank and Shoreline Protection, and Tree / Shrub Establishment.

Factors Hypothesized to Influence Crawfish Producers' Decisions to Adopt BMPs

For the logit models, independent variables and their means are shown in Table 2. ACRES is the number of acres on the farm. Larger sized farms have generally been associated with an increased likelihood to adopt technology (El-Osta and Morehart). Higher fixed cost of production has generally been negatively associated with technology adoption (Feder, Just, and Zilberman). CASH and SHARE indicate whether the producer rents crawfish land using a cash lease or a share lease, respectively.

Previous research has shown land tenure system to be important in affecting the adoption of conservation practices (Soule, Tegene, and Wiebe).

Additional independent variables include: portions of the crawfish production land that are double-cropped with rice (RCDC) or in a rotation with rice, soybeans, or fallow (ROTATION); whether the farm is leased for hunting (HUNTLEASE); years the producer has farmed crawfish (YEARS); whether the producer holds a college bachelor's degree (COLLEGE); portion of household income from the farm (%INCFARM); portion of farm income from crawfish (%INCCF); the producer's age (AGE); and whether a stream / river runs through the farm (STREAM).

Two additional variables are included. Producers were asked, "Relative to other investors, how would you characterize yourself?" Potential responses were, "I tend to take on substantial levels of risk in my investment decisions", "I tend to avoid risk when possible in my investment decisions", and "I neither seek nor avoid risk in my investment decisions." This question was first used by Fausti and Gillespie. RISKAVERSE indicates that the producer chose the second option. Producers were asked, "Compared to other farmers in your area, which of the following best describes your willingness to adopt new technologies?" Potential responses were, "I tend to adopt new technology earlier than most of my neighbors; I tend to adopt technology along with most of my neighbors", and "I tend to wait until others have adopted to see how well the technology works before adopting." EARLYADOPT indicates that the producer chose the first option.

Results

Table 2 shows the percentage of producers adopting individual BMPs. The most highly adopted BMP was Irrigation Water Management with a 78% adoption rate. Following that, Irrigation Land Leveling had an adoption rate of 73%. Irrigation Water Conveyance via a Pipeline, Nutrient Management, and Conservation Cover followed with greater than 50% adoption rates each. Critical Area

Planting and Field Border were adopted by nearly 50% of the producers. Practices with lower (<15%) adoption rates were Range Planting, Irrigation Regulating Reservoir, Tree / Shrub Establishment, Riparian Forest Buffer, and Irrigation Storage Regulating Reservoir, and Streambank and Shoreline Protection. Each BMP would not necessarily be suitable for every farm, depending upon land and farm characteristics, as well as other crops raised on the farm.

Table 3 shows the means of independent variables. The average farm size was 686 acres. Approximately 30% of the producers farmed under a cash lease while 13% farmed under a share lease. Approximately 28% of the land was in a rotation and 19% was double-cropped with rice. Approximately 13% of the producers leased their farm for hunting purposes.

Tables 4 and 5 show results of the probit runs, with Table 4 showing the β coefficients and marginal effects and Table 5 summarizing the results as to whether independent variables had positive or negative significant effects on BMP adoption. Goodness of fit varied by BMP, with the pseudo R-square ranging from 0.154 for Grassed Waterways, where no factor was found to be significant, to 0.506 for Filter Strips. Correlation coefficients were examined, with no evidence of multicollinearity found. The number of observations used for each run ranged from 45 to 54, depending upon the number of completed responses. The relatively small number of observations likely contributes to relatively low levels of significance in some of the runs.

As expected, the larger the farm size, the more likely was the adoption of four BMPs. Cash lease shows a positive relationship with Irrigation Land Leveling but was negatively associated with Field Border and Irrigation Water Management. On the other hand, holding a share lease was positively associated with Conservation Cover. This suggests that tenancy has mixed effects on BMP adoption, depending upon the BMP. It will be worthwhile to investigate this further, as some BMPs may be particularly more likely to be required by the landlord, especially in cases where the landlord is also the producer of an associated rotation crop.

It was determined that the number of years the producer had farmed is positively related to the adoption of five BMPs, though no relationship with the producer's age was found. This suggests that greater experience with crawfish farming leads to greater use of conservation practices. Percentage of household income from the farm is significant for three BMPs, suggesting that greater financial importance of the farm to the household income increases the use of conservation practices. On the other hand, a higher percentage of farm income from the crawfish operation negatively influenced the adoption of Conservation Cover and Filter Strips.

As expected, producers who considered themselves to be early technology adopters were more likely to adopt BMPs than those who considered themselves to be late adopters. Surprisingly, having a stream running through the farm negatively influenced adoption.

Conclusions and Discussion

This study represents the first attempt for which the authors are aware to assess the adoption of BMPs in the U.S. crawfish industry. As with other Louisiana animal agricultural enterprises, as analyzed for dairy (Rahelizatovo) and beef (Kim), adoption rates varied widely by BMP. Though four contacts were made with 770 producers using Dillman's total design method, only a 14% response rate was achieved. This naturally raises the specter of questions regarding sample representativeness. Similar efforts in which the principal investigator was involved with other populations regarding BMP adoption resulted in greater response rates for dairy (Rahelizatovo) of 29% and beef (Kim) of 41%; it is the opinion of the investigators that the methodology used was valid.

A number of factors were found to be consistent in influencing BMP adoption in crawfish production. Larger farms where the operator had been producing crawfish longer, had a higher percentage of income from the farm, and where the operator considered himself to be an early adopter of technology in general were more likely to have adopted BMPs. On the other hand, in cases where a stream ran through the farm or the percentage of farm income from crawfish was higher, adoption was lower. Results with respect to land tenancy, crop rotation, and double-cropping behavior were mixed, such that in some cases these positively influenced adoption, and in other cases the influence was negative. The consistent message, however, is that larger-scale crawfish farms that are able to achieve greater amounts of household income from the farm are those that are the greater BMP adopters. This would suggest that policies that enable farmers to attain suitable income such that off-farm income sources become less important to the farmer will encourage greater BMP adoption in this industry.

Areas of research that need further examination and that the authors are currently pursuing include: (1) determining reasons for crawfish farmers adopting or not adopting BMPs and (2) further examination of the landlord-tenant relationship and any interactions these may have with different rotation strategies.

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Table 1. Description of the Best Management Practices Used in Crawfish Production

Best Management Practice	Description
Conservation Cover	The practice of establishing and maintaining permanent vegetative cover. This helps in improving air, water, and soil quality as well as in reducing soil erosion.
Critical Area Planting	The establishment of permanent vegetation on sites that have high erosion rates, and on sites that have conditions that prevent establishment of vegetation with normal practices.
Field Border	A strip of permanent vegetation established at the edge or perimeter of a field. It helps reduce soil erosion, improve soil and water quality, and increase carbon storage.
Grade Stabilization Structure	A structure used to control the slope in natural or artificial channels.
Filter Strips	Strips of grasses or other close-growing vegetation planted around fields and along drainage ways and water bodies. The purpose is to reduce sediment, organic material, nutrients, and chemicals carried in runoff, in the case of crawfish production in inflow and discharging water.
Grassed Waterway	A natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation.
Irrigation Water Management	The process of controlling irrigation water volume, frequency, and application rate for forage and crawfish in a planned, efficient manner.
Irrigation Land Leveling	Reshaping the surface of land to be irrigated to planned grades.
Irrigation Storage Reservoir	An irrigation water storage structure made by constructing a dam, embankment, or pit. It holds water in storage until it is used for irrigation. A small storage reservoir constructed to regulate an irrigation water supply.
Irrigation Regulating Reservoir	It is designed primarily for flow control or to store water for a few hours or days, but does not generally include detailed design criteria.
Irrigation System with Tailwater Recovery	A planned irrigation system with facilities installed for collection, storage, and transportation of irrigation tailwater and/or rainfall runoff for reuse.
Irrigation Water Conveyance via a Pipeline	A pipeline installed in an irrigation system to prevent erosion, loss of water quality, or damage to land.
Nutrient Management	Managing the amount, source, placement, form and timing of the application of plant nutrients and soil amendments.
Pumping Plant	It is used to transfer water for a conservation need.

Range Planting	The establishment of perennial vegetation such as grasses, forbs, legumes, shrubs and trees.
Riparian Forest Buffer	An area of predominantly trees and/or shrubs located adjacent to uphill from a water body.
Streambank & Shoreline Protection	A treatment used to stabilize and protect banks of waterbodies: lakes, streams, constructed channels, reservoirs, or estuaries.
Tree/Shrub Establishment	The establishment of woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration.

Table 2. Adoption Rates of Best Management Practices.

Best Management Practice	Percentage Adoption
Conservation Cover	52
Critical Area Planting	47
Field Border	42
Grade Stabilization Structure	35
Filter Strips	22
Grassed Waterway	20
Irrigation Water Management	78
Irrigation Land Leveling	73
Irrigation Storage Reservoir	6
Irrigation Regulating Reservoir	12
Irrigation System with Tailwater Recovery	15
Irrigation Water Conveyance via a Pipeline	58
Nutrient Management	55
Pumping Plant	25
Range Planting	12
Riparian Forest Buffer	5
Streambank & Shoreline Protection	1
Tree/Shrub Establishment	8

Table 3. Means of Independent Variables Used in the Logit Models.

Independent Variables		Mean
ACRES	Cts: Number of acres on the farm	685.625
CASH	Dummy: Producer rents crawfish land using a cash lease = 1	0.304
SHARE	Dummy: Producer rents crawfish land using a share lease = 1	0.125
RCDC	Cts: Portion of crawfish land double cropped with rice	0.194
ROTATION	Cts: Portion of crawfish land rotated with rice and/or soybeans	0.275
HUNTLEASE	Dummy: Farm leased for hunting = 1	0.125
YEARS	Cts: Years the producer has farmed crawfish; 1: 1-7 years; 2: 8-14 years; 3: 15-21 years; 4: 22-28 years; 5: 29-35 years; 6: 36-42 years; 7: ≥43 years.	3.196
COLLEGE	Dummy: Producer holds a college bachelor's degree or more = 1	0.357
%INCCF	Cts: Percent of farm income from the crawfish operation; 1: 1-19%; 2: 20-39%; 3: 40-59%; 4: 60-79%; 5: 80-100%	2.018
%INCFARM	Cts: Percent of household income from the farming operation; 1: 1-19%; 2: 20-39%; 3: 40-59%; 4: 60-79%; 5: 80-100%	3.071
AGE	Cts: Farmer's age	2.482
RISKAVERSE	Dummy: Farmer response, "I tend to avoid risk when possible in my investment decisions" = 1	0.464
EARLYADOPT	Dummy: Farmer response, "I tend to adopt new technology earlier than most of my neighbors" = 1	0.321
STREAM	Dummy: Farmer response, "A stream/river runs through my farm" = 1	0.393

Table 4. Coefficients and Marginal Effects of Probit Best Management Practice Adoption Runs.

VARIABLES	Conservation Cover		Critical Area Planting		Field Border		Grade Stbln Structure	
	Coefficient	Marg. Effect	Coefficient	Marg. Effect	Coefficient	Marg. Effect	Coefficient	Marg. Effect
ACRES	0.00052	0.00021	0.00064 **	0.00025 **	0.00023	0.00008	-0.00004	-0.00001
CASH	-0.48453	-0.19139	0.58073	0.22791	-1.65442 **	-0.44695 **	-0.72784	-0.24239
SHARE	1.13169 *	0.38379 **	0.23700	0.09395	-0.79664	-0.22751	0.40223	0.15318
RCDC	-1.61475 **	-0.64203 **	0.61309	0.24073	0.30228	0.10573	0.09573	0.03479
ROTATION	-3.60191 **	-1.43214 **	-1.29012 *	-0.50658 *	-0.39006	-0.13643	0.02754	0.01001
HUNTLEASE	-1.92851 **	-0.57739 **	-0.58722	-0.21403	0.07349	0.02605	-0.92548	-0.27003 *
YEARS	0.33969 **	0.13506 **	0.04245	0.01667	0.04487	0.01569	0.18807	0.06835
COLLEGE	-0.43465	-0.17196	0.35035	0.13785	-0.69390	-0.22854	0.34499	0.12704
%INCCF	-0.35320 **	-0.14044 **	-0.23250	-0.09129	0.00633	0.00221	-0.19672	-0.07149
%INCFARM	0.46091	0.18326 **	0.26418	0.10373	-0.05574	-0.01949	0.30314	0.11017
AGE	0.34361	0.13662	0.03941	0.01547	-0.19727	-0.06900	-0.02669	-0.00970
RISKAVERSE	-0.72980	-0.28419	0.74878	0.28815	0.49209	0.17203	-0.36105	-0.13006
EARLYADOPT	1.80997 **	0.59813 **	1.54295 **	0.55694 **	-0.47108	-0.15629	1.39755 **	0.50818 **
STREAM	-1.14973 **	0.43359 **	-0.19143	-0.07470	-0.86497 *	-0.27950 *	0.16406	0.06008
Obs	52		54		53		53	
Pseudo R^2	0.4463		0.3007		0.2893		0.2854	

Notes: ** indicates the variable is significant at the 0.05 level; *indicates the variable is significant at the 0.10 level.

VARIABLES	Filter Stripes				Grassed Waterways				Irrgn. Water Mngt.				Irrgn. Land Leveling			
	Coefficient		Marg. Effect		Coefficient		Marg. Effect		Coefficient		Marg. Effect		Coefficient		Marg. Effect	
ACRES	0.00073	**	0.00003		0.00022		0.00005		0.00167	**	0.00026	**	-0.00021		-0.00002	
CASH	-0.69553		-0.02443		-0.57328		-0.12532		-1.43584	**	-0.31668	**	1.86878	**	0.14296	*
SHARE	0.82678		0.06964		-0.53363		-0.10277		-0.99279		-0.23576		1.02203		0.05925	
RCDC	0.50832		0.02228		0.78520		0.18928		0.50885		0.07786		3.56242	**	0.36555	**
ROTATION	-2.24219	**	-0.09827		0.30026		0.07238		-0.25333		-0.03876		1.65217	*	0.16953	
HUNTLEASE	0.15502		0.00767						-0.14978		-0.02471		0.32968		0.02772	
YEARS	0.18395		0.00806		0.18299		0.04411		0.28155	*	0.04308		0.71073	**	0.07293	**
COLLEGE					-0.68491		-0.15176		-0.03361		-0.00517		1.20727		0.10690	
%INCCF	-0.52540	*	-0.02303		-0.13232		-0.03190		0.25701		0.03933		-0.12546		-0.01287	
%INCFARM	0.57565	**	0.02523		-0.02784		-0.00671		0.03923		0.00600		0.10200		0.01047	
AGE	-0.56478		-0.02475		0.20611		0.04968		-0.36129		-0.05528		0.31481		0.03230	
RISKAVERSE	0.48441		0.02257		0.33100		0.08008		0.47109		0.07137		-0.48299		-0.05111	
EARLYADOPT	0.52675		0.02901		0.07149		0.01755		-0.05891		-0.00915		0.43550		0.03961	
STREAM	-2.01539	**	-0.08954	*	0.34600		0.08754		-0.94276	*	-0.17169	*	0.48611		0.04572	
Obs	53				45				53				54			
Pseudo R^2	0.5063				0.1539				0.3362				0.4908			

Notes: ** indicates the variable is significant at the 0.05 level; *indicates the variable is significant at the 0.10 level.

VARIABLES	**Irrgn. System w TWR**				**Irrgn. Water Conv. Pipe**				**Nutrient Management**				**Pumping Plant**			
	Coefficient		Marg. Effect		Coefficient		Marg. Effect		Coefficient		Marg. Effect		Coefficient		Marg. Effect	
ACRES	0.00083		0.00005		0.00100	**	0.00035	**	0.00036		0.000141		0.00079	**	0.00017	**
CASH	-0.06854		-0.00433		0.07986		0.02754		0.15235		0.059284		-0.68391		-0.12656	
SHARE					0.50863		0.15677		0.02582		0.010099		0.22980		0.05380	
RCDC	-1.33065		-0.08571		1.25397		0.43614		1.63770	*	0.641797	**	-0.97517		-0.20768	
ROTATION	-2.17576	**	-0.14014		0.82082		0.28549		1.92248	**	0.753399	**	0.26957		0.05741	
HUNTLEASE	-0.24046		-0.01299		-0.64502		-0.24311		-0.92787		-0.35346		0.10316		0.02295	
YEARS	-0.16181		-0.01042		-0.04109		-0.01429		0.35610	**	0.13955	**	0.28622		0.06096	*
COLLEGE	-0.58506		-0.03330		0.36399		0.12309		-0.20304		-0.07979		-1.16177	*	-0.21365	**
%INCCF	-0.18556		-0.01195		0.03550		0.01235		-0.28114		-0.11017		-0.04614		-0.00983	
%INCFARM	0.88303	**	0.05688		0.01397		0.00486		0.07106		0.027848		0.04610		0.00982	
AGE	-0.41028		-0.02643		-0.13425		-0.04669		-0.38347		-0.15028		-0.01071		-0.00228	
RISKAVERSE	-0.74335		-0.04703		0.15945		0.05528		0.74694		0.285138		-0.71137		-0.14884	
EARLYADOPT	2.36997	**	0.40648	*	-0.25787		-0.09159		1.15847	*	0.407896	**	-0.26187		-0.05248	
STREAM	-1.05233	*	-0.06275		0.47989		0.16054		0.31685		0.122682		0.20995		0.046073	
Obs	45				53				53				51			
Pseudo R^2	0.4579				0.3146				0.4384				0.3655			

Notes: ** indicates the variable is significant at the 0.05 level; *indicates the variable is significant at the 0.10 level.

Table 5. Summary Table of Statistically Significant Results (Relationship of Dependent and Independent Variables).

	Conscov	Critareap	Fieldb	Gsst	Filtstr	Grassw	Iwmngt	Ilandlev	Isystailre	Iwconvpi	Nutrmngt	Pumpp
ACRES		+			+		+			+		+
CASH			-				-	+				
SHARE	+											
RCDC	-							+			+	
ROTATION	-	-			-			+	-		+	
HUNTLEASE	-			-								
YEARS	+						+	+			+	+
COLLEGE												-
%INCCF	-				-							
%INCFARM	+				+				+			
AGE												
RISKAVERSE												
EARLYADOPT	+	+		+					+		+	
STREAM	-		-		-		-		-			
Obs	52	51	53	53	53	45	53	54	45	53	53	51
Pseudo R^2	0.446	0.366	0.289	0.285	0.506	0.154	0.336	0.4908	0.4579	0.3146	0.4384	0.3655