Equipoise Consulting, Inc.

Evaluation

Project Management

Final Report for

Evaluation of the Center for Irrigation Technology 2004_2005 Agricultural Pumping Efficiency Program

(CPUC Project Number 1418-04, 1428-04, 1434-04)

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In association with

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July 18 2006

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1 Executive Summary

The CSU Foundation, Center for Irrigation Technology (CIT) Agricultural Pumping Efficiency Program (APEP II) was awarded funding from the California Public Utilities Commission (CPUC) to provide an education and incentive-based energy efficiency program. for program years (PY) 2004 and 2005. APEP II ran from March 2004 through December 2005.

1.1 Program Overview and Research Objectives

Based on the plan filed with the CPUC, APEP II executed a multi-faceted approach to reaching agricultural customers and assuring implementation of energy efficient technologies. APEP II built on the prior APEP I program. It operated in the Pacific Gas and Electric Company (PG&E), Southern California Gas Company (SoCalGas), and Southern California Edison Company (pump repair only in SCE) service territories. As with APEP I, the goal of APEP II was to reduce energy use in water pumping systems in both agricultural and commercial turf installations. The two objectives of APEP II were:

1. Get highly efficient pumping systems in place.
2. Manage those systems properly.

The program provided both information and financial incentives to a wide variety of growers and turf managers to attempt to meet their objectives.

According to the CPUC Energy Efficiency Manual, this evaluation needed to address all aspects of the program and provide meaningful feedback to both the program implementer and the CPUC. However, APEP I was thoroughly evaluated by the same evaluation team and found to be working well. The evaluation team used the California Framework[1] in conjunction with discussions the Master Contractor team to determine the appropriate level of evaluation for this program as it entered its third and fourth years.

The evaluation followed the CPUC stipulated objectives as well as one additional objective specific to this assessment. Research was performed to assess the potential for flow meters to increase the efficient use of agricultural pumps.

There are two reports covering this evaluation effort. The first report was completed September 8, 2005 and provided insight into the relationships between the use of a flow meter and energy efficient actions. Since flow meters were not part of the current program, that report investigated a program design issue. The flow meter report is attached in total in Appendix A and high level results are provided in Section 1.2.1. The second report for this evaluation is this document, which contains the energy impacts of the program.

[1] *The California Evaluation Framework.* Prepared for the California Public Utilities Commission and the Project Advisory Group. TecMarket Works Framework Team. February 2004.

1.2 Results of Evaluation

1.2.1 Flow Meter Results

Based on the analyses, it appeared premature to recommend that a full educational component focusing on flow meters be added to the APEP (or any other agricultural program) or to provide incentives for the purchase of flow meters. However, the weak support for the hypothesis that "growers who install flow meters are more likely to make changes to their irrigation management or other pumping system related behavior" along with survey results, supported continuing to educate growers about flow meters. The study shows that growers tend to identify with potential water savings that can be associated with information from flow meters since water applications have a direct relationship to the yields of crops. Energy used to provide the water is one step removed from the growth of crops. Therefore, educational efforts must be much more focused on the water/energy relationship in the use of flow meter information to better manage and reduce energy use through management of water use since grower do not have a "mind-set" that relates energy use to crop production. Other aspects of the study indicate that educational materials should stress that the installation of flow meters can reduce operating costs. This is particularly important since cost is one of the major barriers to the installation of flow meters and reduced operating costs can help to reduce the payback on such a purchase. In addition, these materials could also stress that there are a large number of behavioral and hardware changes that can be better informed using information provided by flow meters. Finally, water use appears to be a more important factor than energy use in the decision to install flow meters. Therefore, while not ignoring the energy benefits, stressing in these educational materials the reduction of water use is recommended.

1.2.2 Impact Results

The gross energy impacts were derived using the methods outlined in Section 4. The default net-to-gross ratio (NTGR) of 0.75 was applied to the gross impact values for both electric and gas measures to obtain annual net energy impacts. As agreed in the research plan, no analysis on demand occurred.

The overall annual impact results are presented in Exhibit 1.1. The net lifecycle impacts for the program based on the evaluation are 71,960 MWh and 1,289,383 therms (i.e., the net annual impacts over a 15 year effective useful life).

Exhibit 1.1
Annual Energy Impacts from APEP II

	Pump Tests	Pump Repairs Electric	Natural Gas
Number of Completes			
Ex Ante	2,000	260	34
Ex Post	1,513	116	4
Realization Rate	76%	45%	12%
Gross Impacts		(kWh)	(Therm)
Ex Ante	NA	9,242,500	76,500
Ex Post	NA	6,396,423	114,612
Realization Rate	NA	69%	150%
Net Impacts		(kWh)	(Therm)
Ex Ante	NA	6,931,875	57,375
Ex Post	NA	4,797,318	85,959
Realization Rate	NA	69%	150%

There were 116 repairs of electric pumps accepted into the APEP II program from March 1, 2004 to December 31, 2005. The average net electrical energy impact per pump repair was 41,356 kWh. On the natural gas side, there were 4 repairs of natural gas pumps resulted in an average net therm impact of 21,490 therms per pump repair.

The average customer cost for a pump repair was $16,093 with the incentive averaging 23 percent of the customers cost.

1.3 Conclusions and Recommendations

The APEP II program provided a little over two-thirds of the expected net electric energy impacts, exceeded the net therm impacts by 50 percent and completed 76 percent of the pump tests planned. While there may have been reasons behind why the program missed their target for the electric impacts and pump tests, the evaluation did not perform a process evaluation to determine the root cause. However, a conversation with the program manager indicated that marketing and a late entry into the municipals market were relevant issues that may have contributed to the realization rates.

The empirical evidence seems to indicate that mass media marketing of this type of program is not very successful. Actual face-to-face interactions that took place through the pump tests in the PG&E service territory may have helped increase the visibility of the program and subsequent repairs.

The recommendations from this evaluation are:

1. The APEP program or any other agricultural program should not offer a full educational component focusing on flow meters nor should it provide incentives for

the purchase of flow meters. However data suggests that ongoing education on flow meters combined water and energy cost savings may be beneficial.

2. Any future pump repair programs should seriously consider the use of personal interactions as the main avenue for marketing the available service.
3. If natural gas engines are targeted in the future, the per-repair goal should be increased to be more in line with what has been found in the four years of this program. Based on the 17 repairs performed over the past four years, a value of 20,000 therms per repair is recommended.
4. Services such as that offered by the APEP II should be continued.
5. The CIT is a knowledgeable and appropriate company to provide similar services in the future. The CIT has provided a program that had interactions and synergies with other agencies, created and used mobile energy centers to a positive advantage, provided a smoothly flowing program process, successfully provided pump tests, increased awareness and knowledge of specific efficiency practices, and saved energy.

The next sections provide detail about the program, method used in the evaluation, and results.

2 Overview

In 2002, the California State University (CSU) Foundation Center for Irrigation Technology (CIT) Agricultural Pumping Efficiency Program (APEP I) was awarded funding from the California Public Utilities Commission (CPUC) to provide an education and incentive-based energy efficiency program. The Program began in October of 2002 and, due to extensions approved by the CPUC, continued through December 2005. The program was re-funded for program years (PY) 2004 and 2005 with the name Agricultural Pumping Efficiency Program II (APEP II). APEP II has run from March 2004 through December 2005. While the two programs overlapped, the accounting for energy impacts has been separate. An evaluation errata report followed up on the APEP I after it's completion in December 2005 that covered only the impact from measures under the PY2002-2003 program (see CIT0001.01, CIT0001.02 and CIT0001.03 on the www.calmac.org searchable database for the reports on APEP I).

The evaluation of APEP II was conducted by Equipoise Consulting Inc., in conjunction with California AgQuest Consulting Inc, Ridge & Associates, and Vanward Consulting (the Team). This evaluation is covered by two reports. The first report was completed September 8, 2005 and addressed the use of flow meters and provided insight into the relationships between the use of a flow meter and energy efficient actions. Since flow meters were not part of the current program, that report investigated a program design issue. The flow meter report is attached in total in Appendix A. The second report from this evaluation is this document, which contains the energy impacts of the program.

The executive summary presents data from both reports, but all other sections in the body of this report address only the program impact assessment (i.e., the overview, data collection, methods, results and recommendations for the flow meter assessment are in Appendix A.)

2.1 Background on Program

Based on the plan filed with the CPUC, the Program had a multi-faceted approach to reaching agricultural customers and assuring implementation of energy efficient technologies.

APEP II built on APEP I and operated in the Pacific Gas and Electric Company (PG&E), Southern California Gas Company (SoCalGas), and Southern California Edison Company (pump repair only in SCE service territory) service territories. As with APEP I, the goal of APEP II was energy conservation in water pumping systems in both agricultural and commercial turf installations. The two objectives of APEP II were:

1. Get highly efficient pumping systems in place.
2. Manage those systems properly.

The four program components in APEP II were:

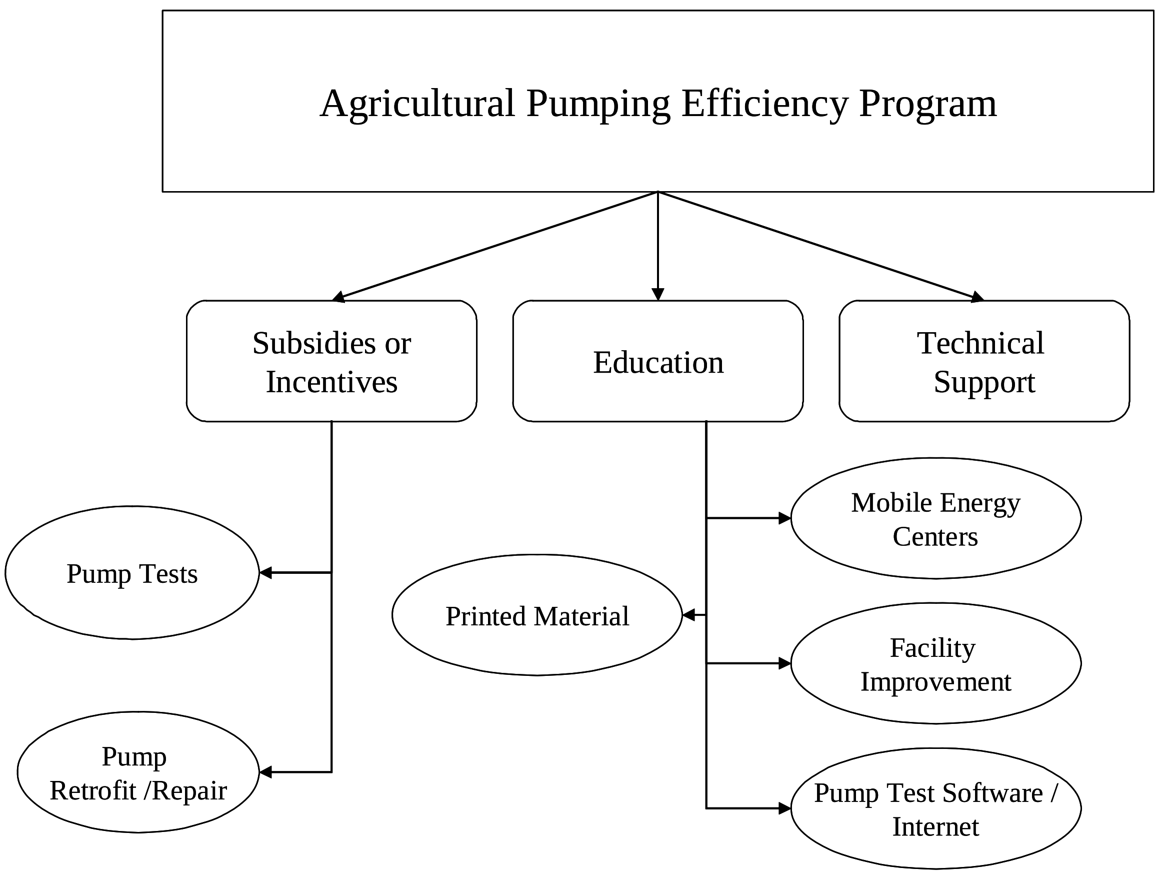
- Education to improve pumping system selection, maintenance, and operation as well as overall water management. The basic educational message had four parts:
    1. Know how to specify an efficient pump.
    2. Know how to maintain an efficient pump.

3. Know how much water needs to be pumped.
4. Know how much water has been pumped.

- Technical assistance to improve pumping system selection and overall energy efficiency, as well as to provide aid in arranging for a pump test or completing incentive rebate applications.
- Subsidized pumping plant efficiency testing (an audit of the pumping plant) to develop objective information necessary to enable a benefit/cost analysis for a pump retrofit/repair.
- Direct incentives for retrofit or repair of pumping plants to improve efficiency.

Information was provided both to a broad spectrum of growers and a targeted audience of smaller and medium-sized growers. The information was provided through multiple avenues (discussed below). Once the customers become both aware and knowledgeable, the program provided financial incentives to help growers implement more energy efficient technologies. The basic structure of the program is illustrated in Exhibit 2.1.

Exhibit 2.1
Program Structure



Mobile Energy Centers (MECs) were an integral part of the program. These MECs traveled around the state to grower meetings and events and provide energy efficiency information and hands-on demonstration of how a pump's efficiency can affect grower costs. The APEP II also provided information and useful "tools" (i.e., computer programs to help growers make informed decisions) via the Internet (http://www.pumpefficiency.org/education.htm). Many pages on this website were provided in both English and Spanish. In this part of the program, information is disseminated to a broad spectrum of growers.

Technical support helped customers find pump testers or fill out forms as needed. Staff was prepared to answer questions from both customers and vendors.

Because the implementation of potential solutions requires financial investments, growers or turf managers may be reluctant to participate. To reduce this cost barrier, the program provided subsidies for pump testing to determine the overall efficiency of the pumping plant, and incentives for pump repair or replacement of inefficient pumping plants.

As shown in this short overview, the program provided both information and financial incentives to a wide variety of growers and turf managers. According to the CPUC Energy Efficiency Manual, this evaluation needs to address all aspects of the program and provide meaningful feedback to both the program implementer and the CPUC. However, APEP I was thoroughly evaluated by the same evaluation team. Because of this previous work, there are aspects of APEP II for which it was felt that a similar repeated evaluation would be redundant. The evaluation team used the California Framework[2] to help determine the appropriate level of evaluation for this program as it entered its third and fourth years. The evaluation team also had conversations with the Master Contractor team to discuss the planned research approach. The next section outlines the research plan for this evaluation as discussed with and agreed to by the Master Contractor and the CPUC.

2.2 Evaluation Objectives

The evaluation followed the CPUC stipulated objectives as well as one additional objective specific to this assessment. Overall, the previous evaluation showed that the APEP I program was working well and was a successful program. Because of these findings and the feeling that simply reiterating the previous evaluation would be redundant and not a good use of evaluation funds, the evaluation team decided to look into areas of the program where evaluation research could enhance future program design. After discussions among the evaluation team members, and then with the program manager, water flow meter use in agricultural pumping emerged as an area that had the potential to increase energy efficient use of a pump. At the same time, little was known about how flow meters are currently used in the field or whether the growers would accept them as an energy efficiency measure. The concept of researching these issues was discussed with the Master Contractor and ultimately agreed upon and assessed. Therefore the one additional objective was to assess the potential for flow meters to increase the efficient use of agricultural pumps (reported in the flow meter report, attached in Appendix A).

Because APEP I was subjected to a thorough analysis of program impacts (i.e., links within the program theory were assessed), there was no need to revisit many of these issues as a part of this evaluation. However, because APEP II provides subsidies for

[2] *The California Evaluation Framework.* Prepared for the California Public Utilities Commission and the Project Advisory Group. TecMarket Works Framework Team. February 2004.

pump testing and/or incentives for changing pumping equipment in order to achieve energy savings, this element of the Program underwent a measurement and verification.

2.3 CPUC Stipulated Items

The CPUC required that a set of eight overall objectives as well as specific EM&V components be addressed in each evaluation. These Energy Efficiency Policy Manual (EEPM)[3] objectives are presented in Exhibit 2.2 in order to make it clear how the evaluation addressed each.

Exhibit 2.2
Meeting the CPUC Stipulated Objectives

CPUC Objective	*How evaluation met objective*
Measuring level of energy and peak demand savings achieved. (except information-only)	*The Equipoise Team used IPMVP Option A to measure the energy impact of the program as detailed in the write-up below (under EM&V Component) and Section 4.2. No peak demand impacts were expected and peak demand savings were not assessed.*
Measuring cost-effectiveness (except information-only)	*The evaluation used a verification process to track pump tests and pump repairs. The verifications took place in January 2005 (covering all 2004 projects) and May 2006 (covering all 2005 projects).*
Providing up-front market assessments and baseline analysis, especially for new programs	*Since a market assessment was completed in 1998 and a market needs study was completed in 2000, a market assessment or baseline analysis was not done as a part of this evaluation. The pump test and pump repair market is not expected to have changed radically since these studies..*
Providing ongoing feedback and corrective and constructive guidance regarding the implementation of programs.	*The Team provided communication both orally and via email to the program manager as needed. Additionally, written recommendations are provided in this report.*
Measuring indicators of the effectiveness of specific programs, including testing of the assumptions that underlie the program theory and approach.	*The program theory was created in the evaluation of APEP I. As the APEP II was implemented identically, there was no need to adjust the theory. The majority of the assumptions underlying the theory were assessed previously in the APEP I evaluation. No further testing of theory occurred within this evaluation.*
Assessing the overall levels of performance	*The Team assessed the extent to which the Program achieved its stated objectives through the*

[3] California Public Utilities Commission. (2003) *"Energy Efficiency Policy Manual Version 2."* Prepared by the Energy Division of the California Public Utilities Commission.

CPUC Objective	***How evaluation met objective***
and success of programs.	*measurement and verification of pump tests and pump repairs.*
Informing decisions regarding compensation and final payments.	*The Team tracked the total kWh impact in comparison to the planned kWh objectives for the program and provided this data as needed to the Program Implementer and/or CPUC to inform decisions regarding compensation and final payments.*
Helping to assess whether there is a continuing need for the program.	*The Team used all the information gathered during this evaluation to help assess the need for this Program in the future. Specifically, if the program implementer met the overall program energy goals, it was assumed that the program was able to market their program effectively, that there was a desire for their services within the agricultural and pumping population, and that the program should be continued.*

EM&V Components for the Pump Repairs

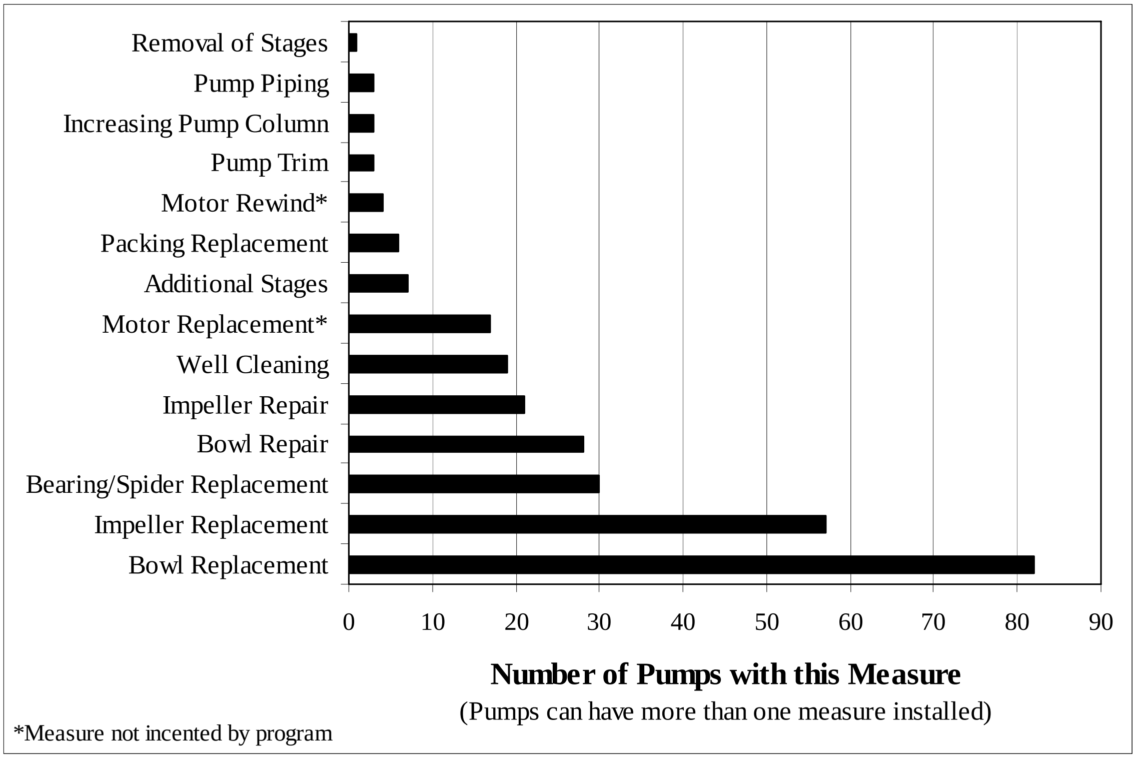
Baseline Information

For the energy component of the Program, the baseline is defined as the state of the customer before program participation. The pre-repair pump tests provided all necessary data on the state of the pump before participation.

Energy Efficiency Measure Information

The Program provided incentives for measures that improved the efficiency of pumping systems. The measures ranged from new pump bowls to cleaning the well. Exhibit 2.3 shows the measures installed through APEP II. As can be noted from this exhibit, a single pump repair could consist of multiple measures at one time (i.e., a pump repair could have both an impeller and bowl replacement).

Exhibit 2.3
Energy Efficiency Measures Installed by the APEP II Program



<ins>Measurement and Verification Approach</ins>

The measurement and verification of the pump repair measures was done through database and paper documentation review of a sample of the repairs paid in each quarter. The number of pump repairs verified by this method was randomly chosen to provide the evaluation team with a 95% confidence level (± 5%) that there were no errors in the database and that the pump repair occurred. No onsite audits were feasible for these measures due to the nature of the measure (i.e., the measure, when not under repair, is often at the bottom of a well).

A default net-to-gross ratio that was stated in the program implementation plan (0.75) was applied to the gross energy impact estimate to arrive at to arrive at the final evaluation net energy impacts. No net-to-gross analysis occurred in this evaluation.

<ins>Evaluation Approach</ins>

The energy impact evaluation approach is covered in detail in Section 4.

3 Data Collection

The evaluation team used the data from the program tracking database to calculate the energy impacts for the pump repairs that had occurred as of the time the program encumbered funds. Verification covered all pump tests and pump repairs paid under the PY2004/2005 program. Following the procedure outlined in Section 4.1, the evaluation team requested and verified the data as indicated in Exhibit 3.1.

Exhibit 3.1
Data Points for Verification

	APEP II Pump Tests		APEP II Pump Repairs	
Verification Period	**N of Population**	**N of Verification**	**N of Population**	**N of Verification**
All quarters 2004	269	25	5	2
All quarters 2005	1,244	90	115	53
Program Total	**1,513**	**115**	**120**	**55**

The low numbers shown in Exhibit 3.1 for 2004 is caused by the overlap in the APEP I and APEP II programs. The total population used and verified during that verification period was larger and included both programs. However, only the APEP II pump tests and pump repairs are shown above.

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4 Study Method

Two methods were employed during the assessment of the energy impacts. First, the data was verified using the method outlined in Section 4.1. Then the energy impacts were calculated using the method described in Section 4.2.

4.1 Verification of Data

While the Team relied on the data from the Program to calculate energy impacts from the pump repairs, a verification of the data occurred. An analysis of the database in which the data reside was performed along with verification of the electronic data through review of a sample of the original paper input source.

The second part of the incentive component of this Program includes incentives provided directly to pump test companies in order to offset the cost of a pump test to a customer. While there are no energy impacts expected from these tests, the Team performed a verification of the payment interaction at the same time as the pump repair verification.

The verification process followed the flow sheets shown in Exhibit 4.1 through Exhibit 4.3. The first graphic shows the overall flow. The second describes the specific two assessments while the third specifies the exact data that was provided to Equipoise during these efforts.

Because the pump repair analysis included all participants, there were no plans to adjust the number of repairs claimed by the program implementer. Any adjustments in the estimated kWh impact from these repairs occurred at the time of the analysis. For the pump tests, if a discrepancy was found in the number of tests claimed and verified, the information was planned to be passed to the program implementer and indicated in the report as well. The number of total pump tests were planned to be adjusted based on a ratio of the verified tests to the total tests.

Exhibit 4.1
Verification Flow Chart

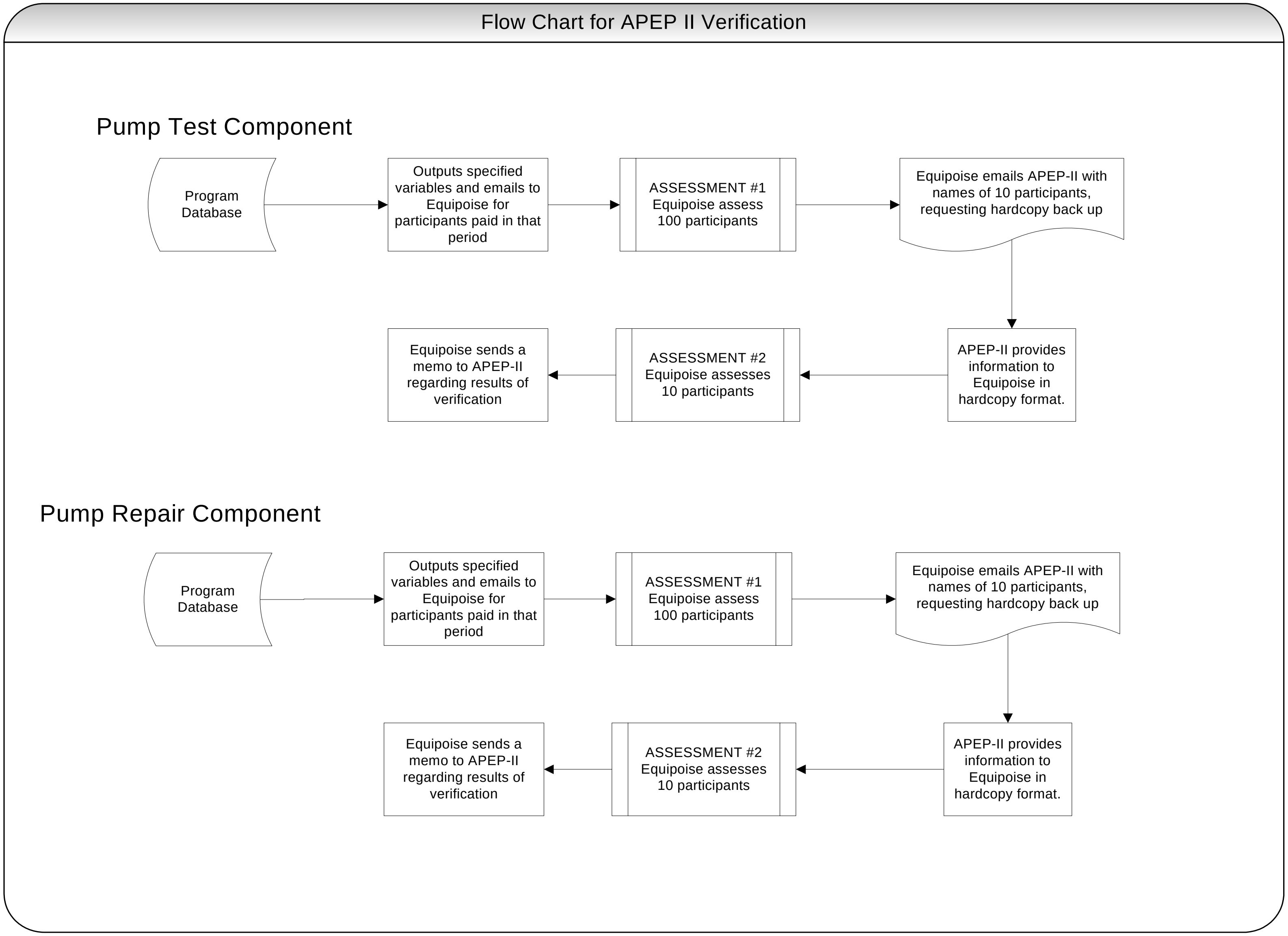


Exhibit 4.2
Assessments #1 and #2 Flow Chart

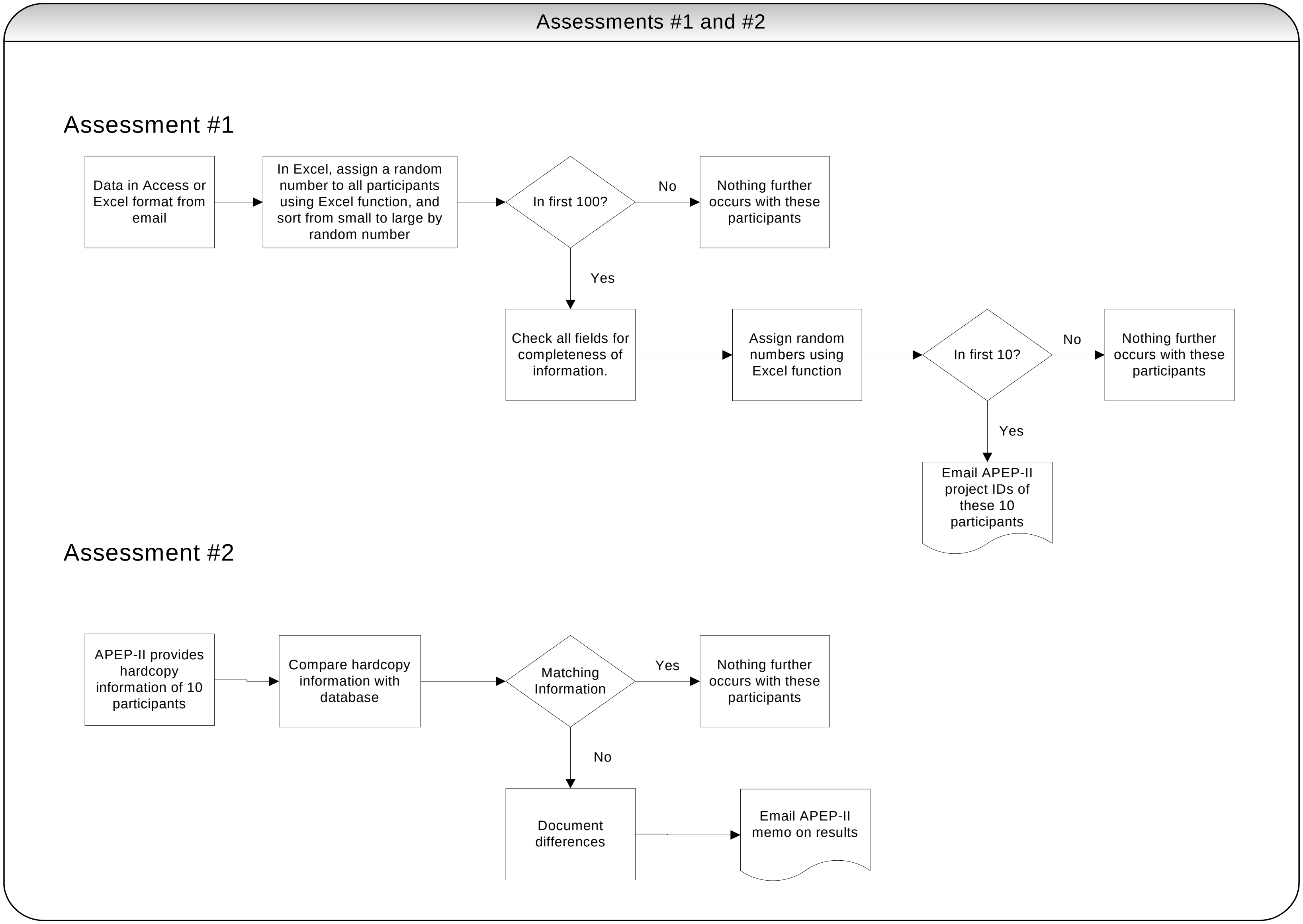


Exhibit 4.3
Specific Data Requested

Verification Data

Pump Test Database Variables

Table APEP Pump Tests - all variables in table, but only for those records PAID in that period
Request hardcopy by meter number and APLRPT Tester Number

Pump Test Hardcopy

Copy of information in program files:
- Invoice from pump tester that maps to this test
- Record of test
- Picture of test
- Access Agreement

Pump Repair Database Variables

tblAPEPProjects - all variables in table, but only for those records PAID in that period
Request hardcopy by APEP Number

Pump Repair Hardcopy

Copy of information in program files:
- Application with signature included
- Paid invoice and notice of project completion
- Pre- and Post-Repair pump tests
- Payment Authorization

4.2 Measurement of Energy Impacts

The CPUC has stipulated that the measurement and verification of the local programs must adhere to guidelines in the International Performance Measurement and Verification Protocol (IPMVP). For this Program, Option A of the IPMVP is the most appropriate approach to use. This is called the Partially Measured Retrofit Isolation approach in which savings are determined by partial field measurement of the energy use of the system to which an energy conservation measure (ECM) is applied. It is an engineering calculation using post-retrofit measurements and stipulations. In this case, the pre- and post-retrofit pump tests[4] supply the majority of the parameters of the energy savings, but billing data is required to obtain estimated annual energy savings. It is the billing data that is the stipulated parameter within this option.

The IPMVP is a set of protocols that outline requirements for sites, not for whole programs. Under these guidelines, each grower that implements an energy saving measure affecting the pump would be required to have a post-retrofit pump test. Since this was already done as part of the Program[5] implementation, there was no deviation from IPMVP Option A.

There were two algorithms used in the measurement of the energy savings. The main algorithm used to calculate energy savings from the pump repairs is shown in Exhibit 4.4.

Exhibit 4.4
Main Energy Impact Algorithm

$$\text{Program Impact} = \sum_{i=1}^{j} \text{kWh}_{12\text{ months, i}} * \left(1 - \frac{\text{OPE}_{\text{pre, i}}}{\text{OPE}_{\text{post, i}}}\right)$$

Where:

j	=	number of pump repair participants.
kWh	=	12 months of pre-repair billing data from the pump – obtained from the grower. This value would be therms in the case of a natural gas engine pump.
OPE	=	operating pump efficiency, pre and post, from pump tests on that pump.

While 68 percent of the pump repairs used the algorithm in Exhibit 4.4, 32 percent did not. There were three reasons for using the alternate algorithm (shown in Exhibit 4.5). The most obvious reason to use the alternate algorithm was when an OPE could not be determined. For example, at times the well could not be sounded, an action required to obtain the depth of the water and part of the calculation of the OPE. While the OPE could not be calculated, another value (the kWh/acre foot of water pumped) was provided from the pre-retrofit and post-retrofit tests. For these type of sites, the algorithm shown in Exhibit 4.5 was used. Fourteen percent of the pump repairs analyzed used this alternate method of calculating energy impacts because of the lack of OPE values. Additionally, a field in the program database indicated that twelve percent of the repairs had changed the motor horsepower of the pump. The use of the main algorithm (Exhibit 4.4) does not adequately capture the impact of the horsepower change and the decision was made to use the alternate algorithm to estimate savings for these repairs (Exhibit 4.5). The last reason

[4] The program will pay for the either the pre- or post-repair pump test, but not both.

[5]The Agricultural Pumping Efficiency Program, Policies and Procedures Manual, page 3, 11/20/02

to use the alternate algorithm affected seven repairs (six percent of the repairs). It is known that the pumping water level found during pump tests (which are a snap-shot of the pump characteristics) can be quite different. For example, a test performed in the spring after the aquifers have had a chance to regenerate can show a quite different depth in the water compared to the end of summer. When this is the case, the kWh/AF value was considered the most appropriate algorithm to use to estimate impacts. The absolute difference in water depth between the pre- and post-repair pump test pumping water level was analyzed and those whose differences were two standard deviations from the mean <u>and</u> that this difference was at least 30 percent of the total pumping water level were chosen to have the alternate algorithm used.

Exhibit 4.5
Alternate Energy Impact Algorithm

$$AF_i = \frac{kWh_{i,pre}}{\left(\frac{kWh}{AF}\right)_{i,pre}}$$

$$kWh_{i,post} = AF_i * \frac{kWh}{AF}_{i,post}$$

$$kWh\ Impact_i = kWh_{i,pre} - kWh_{i,post}$$

Where:

I	=	pump repair site.
kWh_{pre}	=	12 months of billing data from the pump, this data obtained from the grower.
kWh/AF	=	pre and post values from pump test.

Exhibit 4.6 summarize which algorithms were used for analysis of the pump repairs.

Exhibit 4.6
Summary of Pump Repair Algorithm Used

Algorithm	Reason	N	% of Total Repairs
Exhibit 4.4	Main algorithm	82	68%
Exhibit 4.5	No OPE available	17	14%
Exhibit 4.5	HP change out	14	12%
Exhibit 4.5	Extreme pumping water level change	7	6%

In addition to the first year energy impacts of the pump repairs, the lifecycle impacts were required by the CPUC. In order to provide this value, the effective useful life (EUL) of a pump repair was used. The EUL in the program workbooks was 15 years. The Energy Efficiency Policy Manual (August 2003) indicates an EUL of 15 years for a pump test. Since a pump test is supposed to lead to a pump repair and the value was used in the program workbooks, a 15 year EUL was used for the lifecycle analysis.

5 Results and Conclusions

5.1 Verification of Data

There were no inconsistencies in the database or hard copy information found in the verification process. This was a very thorough database that was kept up-to-date by the program. The hard copy data sent to the evaluation team were clearly labeled and easy to follow. Any questions that arose during the verification process were quickly answered by program staff.

Two verifications of energy impacts from pump repairs and pump test numbers were performed. Memos were sent to the program manager as follows:

- January 28, 2005 – Covered all pump tests and pump repairs in either the APEP I or APEP II program that were paid in 2004.
- June 12, 2006 – Covered APEP II pump tests and pump repairs from January 1, 2005 to December 31, 2005.

These two memos are included in Appendix B.

Plant efficiency data from all 1,513 pump tests in the PY2004-2005 program were analyzed to determine the percentage of pumps tested that appeared to be in need of repair. The pump testers provided an “Ideal OPE” based on the pump type and horsepower of the pumps. A range above and below this Ideal OPE was set to determine if the current OPE fell within what could be construed as a range that did or did not need a pump repair. If the pump motor size was equal to or greater than 200 horsepower (HP), then the “did-not-need-a-repair” range was set at 5 percent above and below the Ideal OPE. Otherwise the range was set to 25 percent above and below the Ideal OPE. The results of this analysis are shown in Exhibit 5.1.

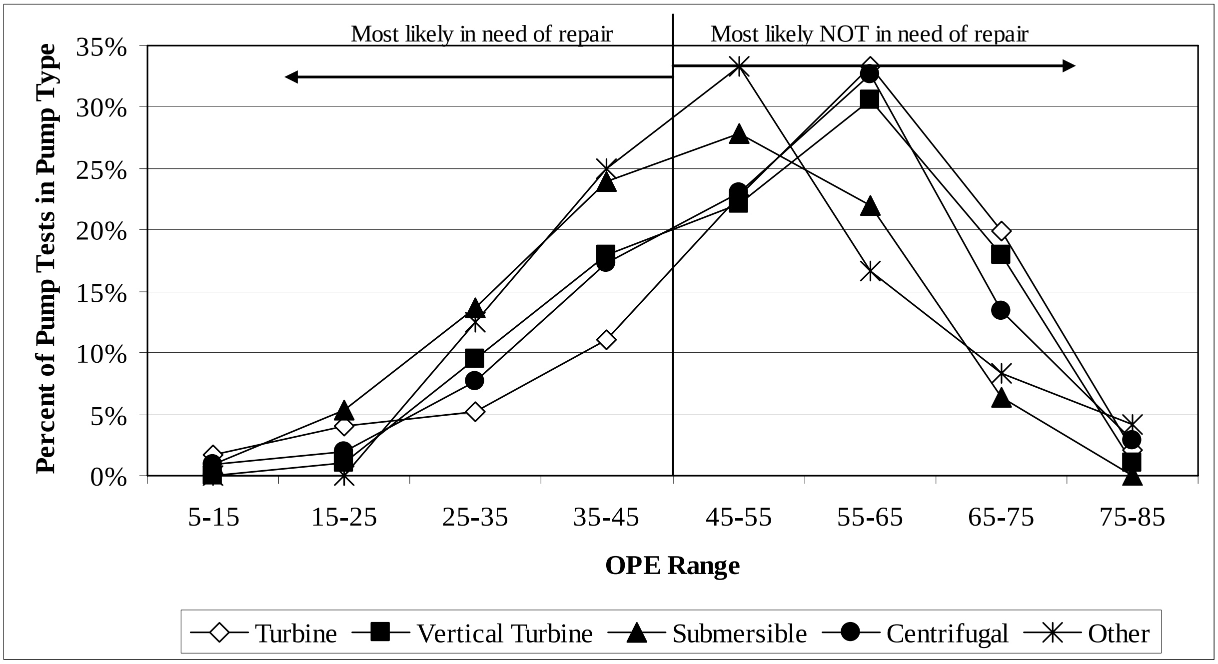
Exhibit 5.1
Pumps by Horsepower - Need Repair

HP	Pump Probably Needs Repair			% Needing Repair
	Yes	No	Unknown*	
0-25	306	107	1	74%
30-50	244	169	0	59%
60-75	187	116	4	61%
80-100	89	59	0	60%
110-125	38	33	19	42%
150-200	71	29	10	65%
250-450	18	10	3	58%
All HP	953	523	37	63%

*not all pumps had an Ideal OPE provided, so this analysis could not occur on these particular pumps.

Another way to look at the pump test data was to see the spread of OPE values by pump type. Exhibit 5.2 shows for each pump type the percent of OPE ranges for tests performed on that particular pump type. The percentages from each pump type sum to 100 percent.

Exhibit 5.2
Percent of OPE Values by Pump Type



[Number of Tests: Turbine (1,085), Vertical Turbine (95), Submersible (205), Centrifugal (104), Other (24)]

While the differentiation of which OPE ranges are in-need or not-in-need of repair varies, for the purposes of Exhibit 5.2, a general determination (OPE < 45) of this is provided to give a sense of the percent of pumps that may need a repair.

Exhibit 5.1 and Exhibit 5.2 together provide considerable detail on the 953 pumps indicating a need for a repair. Exhibit 5.3 combines the data from these two exhibits and shows that there are large pumps being tested that are in need of repairs. While not all the pumps that were categorized as in-need of a repair were analyzed, the six 300 hp and one 450 hp turbine pumps were examined to see if any of these pumps had indeed repaired their pump through the program. Four of the 300 hp pumps were above 60 percent OPE with 70 percent set as the ideal value. One was at 58 percent and one was at 36 percent. The OPE for the 450 hp pump was only slightly less than ideal at 69 percent (with 70 percent OPE set as the ideal value). Based on these values, perhaps only one pump showed a high need for repair, so the data as shown in Exhibit 5.3 should be viewed as a general idea of the percent of pumps needing repair.

Exhibit 5.3
Type and HP of pumps in need of a repair

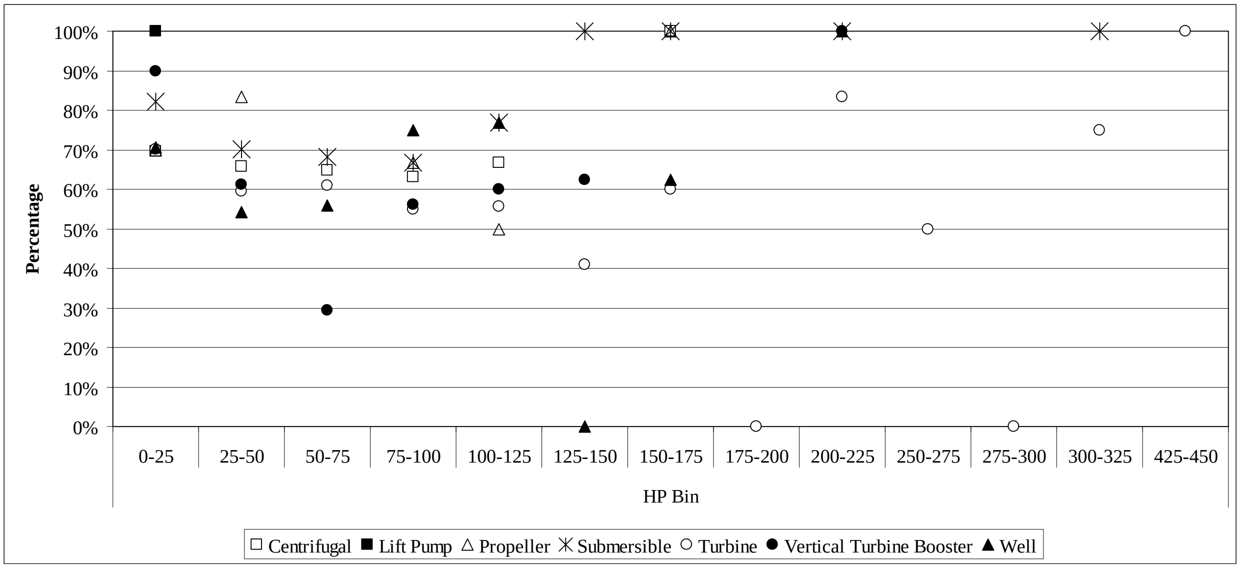


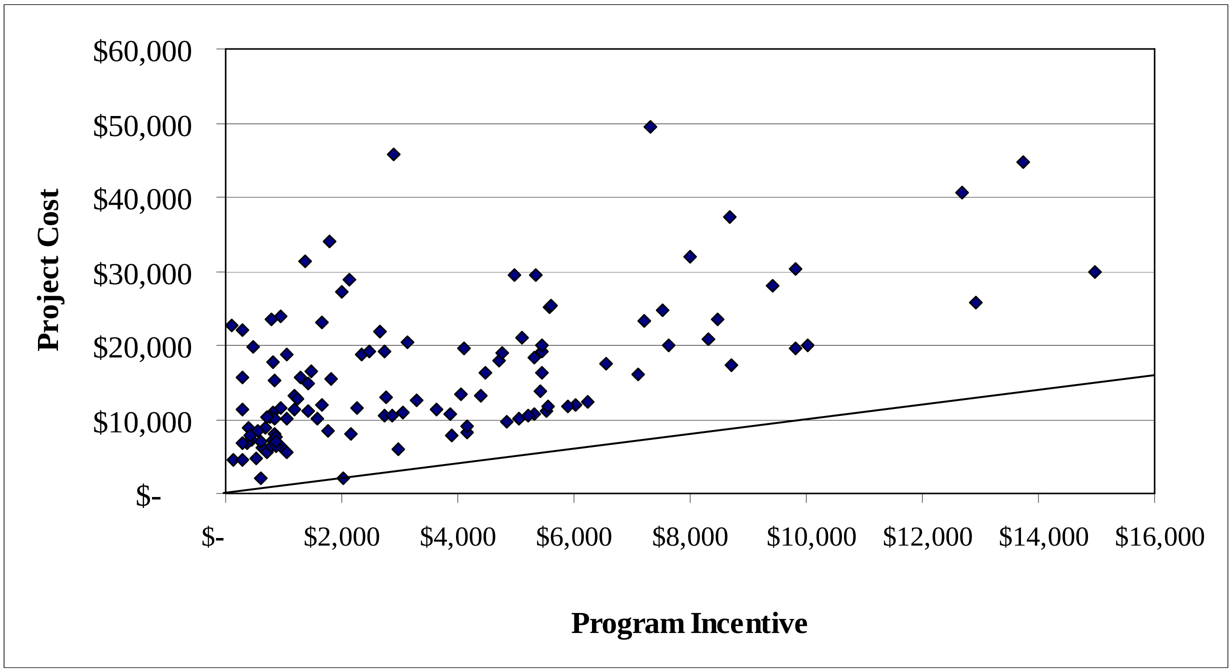
Exhibit 5.1 indicates that 64 percent of pumps could probably benefit from a pump repair. This is very similar to the 61 percent found in the APEP I program. However, of the 1,513 pump tests performed in APEP II, there were 120 pump repairs – only about 8 percent of the time did a test appear to lead to a pump repair. Because of the lag noted in the last report between when a pump test is performed and when the repair is done, pulling in all data from both APEP I and APEP II helps to smooth out some of the timing issues. Exhibit 5.4 provides the information from both programs along with the number of pump tests provided versus the number of repairs performed. Of note, though, is that the program required both pre- and post-repair pump tests, so there are duplicate tests on the pump repair sites. Also, about 14 percent of the pump tests on the repaired pumps were performed by outside vendors in APEP I and about 23 percent in APEP II. Even taking these issues into account, about 18 pump tests were needed to see a single repair across both program years.

Exhibit 5.4
Number of Tests Provided per Repair

Program	Pump Tests	Pump Repairs	Tests per Repair
APEP I	6,193	311	19.9
APEP II	1,513	120	12.6
Both	7,706	431	17.9

It is possible that pump repairs are not done, even when a test indicates one is needed or the customers think they are needed, due to the capital cost of the work. The database contained the actual project cost for each of the 120 pump repairs with incentive payments. The average cost for a pump repair was $16,093, with a standard deviation of $9,285. The median cost was $13,218. The program incentive typically covered 23 percent of the project cost. Exhibit 5.5 shows the scatter plot of the pump repair costs to the incentive grant.

Exhibit 5.5
Project Costs to Program Incentives for Pump Repairs



5.2 Energy Impacts

The energy impacts were calculated using the methods outlined in Section 4.The gross and net program electric energy impacts are shown in Exhibit 5.6 while the program natural gas therm impacts are shown in Exhibit 5.7. Since no demand impacts are expected in this program, as per the research plan, no demand analysis occurred.

There were 116 repairs of electric pumps accepted into the APEP II program from March 1, 2004 to December 31, 2005. The default net-to-gross ratio (NTGR) of 0.75 was applied to the gross impact values to obtain net impacts. The average net electrical energy impact per pump repair was 41,356 kWh.

On the natural gas side, there were 4 repairs of natural gas pumps accepted into the APEP II program from March 1, 2004 to December 31, 2005. The default net-to-gross ratio (NTGR) of 0.75 was also applied to the gross impact values to obtain net impacts. The average net therm impact per pump repair was 21,490 therms.

Exhibit 5.6
Program kWh Impacts

	Total	PG&E	SCE	SoCalGas
Number of Pumps Repaired				
Ex Ante	260	162	98	-
Ex Post	116	98	18	-
Gross kWh Impact				
Ex Ante	9,242,500	6,480,000	2,762,500	-
Ex Post	6,396,423	5,117,518	1,278,905	-
				-
Net kWh Impact				
Ex Ante	6,931,875	4,860,000	2,071,875	-
Ex Post	4,797,318	3,838,139	959,179	-
Ex Post Realization Rates				
Number of Pumps Repaired	44.6%	60.5%	18.4%	-
Net kWh Impact	69.2%	79.0%	46.3%	-

Exhibit 5.7
Program Therm Impacts

	Total	PG&E	SCE	SoCalGas
Number of Pumps Repaired				
Ex Ante	34	8	-	26
Ex Post	4	1	-	3
Gross Therm Impact				
Ex Ante	76,500	18,000	-	58,500
Ex Post	114,612	61,843	-	52,769
				-
Net Therm Impact				
Ex Ante	57,375	13,500	-	43,875
Ex Post	85,959	46,382	-	39,577
Ex Post Realization Rates				
Number of Pumps Repaired	11.8%	12.5%	-	11.5%
Net Therm Impact	149.8%	343.6%	-	90.2%

As the impact tables show, there were substantially fewer pump repairs incented by the program than the program plan expected. However, the repairs that did occur resulted in a higher than expected impact. For example, there were a little less than half the expected electric pumps repaired, yet each brought in more savings resulting in a program realization rate of 69 percent for electrically driven pumps. On the therm side, a little more than 10 percent of the expected pumps were repaired, yet the program engendered 50 percent more than expected therm savings.

The reasons behind why the program missed their target for the electric impacts is unknown with any certainty since the evaluation did not perform a process evaluation to determine the root cause. However, a conversation took place with the program manager to discuss this issue. According to him, there were a few main areas that led to the low realization rates on pump repairs.

- The program was created and run in a "tight" manner, meaning that they would not pay for pump repairs on broken pumps, the program checked on the operating conditions and cut out quite a few of the applications that did not meet their standards. By doing so, the program may have disallowed potential free-riders at the outset and reduced the gross savings that would have otherwise been captured by the program.
- The program manager felt there was a marketing difficulty exacerbated by the fact that the utilities did not help them "get to the people". According to him, utilities indicated they could not help to market one third-party program over another. The program fielded a mass media marketing campaign, even though it was not expected to work well with this market. Within the PG&E service territory, the program also had pump testers in the field which helped to market the program and probably led to 60 percent of the expected pump repairs. While the program performed similar marketing within the SCE service territory, they did not have program pump testers in the field[6] and subsequently only had 27 percent of the expected pump repairs. While this situation was similar to APEP I, the program manager indicated there was more "low hanging fruit" in the previous years than this last two years and the program was able to reach a higher percent of their goals in APEP I.
- The program manager pursued clearance to provide services to the municipals during APEP II. Permission was given when about eight months were left in the program. According to the program manager, each municipal pump can average about 80,000 kWh/year impact per pump while farm pumps result in around 37,000 kWh/year per pump. The program manager felt that they would have gotten closer to their goals if there had been more time to meet the needs of the municipal pumps.
- Therm goals were low compared to what was found by the evaluation because the program was uncertain about the amount of savings that could be expected from each natural gas engine driven pump at the time that the goals were set. A simple conversion of impacts from electricity to therms was done to help determine the goals. Experience has shown that natural gas engines are comparable to 300 hp electric motors that run about 4,000 hours and provide considerable savings. [7]

[6] SCE has had their own pump testing program for many years. While the number of pump tests that occurred in 2004-2005 are unknown, it is assumed that numerous tests occurred. It is unknown how, or if, the APEP program was marketed to the recipients of an SCE pump test.

[7] The ex post average therm savings per pump repair across both APEP I and APEP II was 21,000 therms versus the ex ante estimate of 2,250 therms per pump repair.

5.3 Lifecycle Energy Impacts

This section contains the service utility specific tables of annual energy savings by year in which the measures are expected to provide savings. The total for each table is lifecycle energy savings. The table which sums the per service area impact is provided last.

PG&E Program Energy Impact Reporting for 2004-2005 Programs

Program ID: 1418-04
Program Name: California Irrigation Technology 2004-2005 Agricultural Pumping Efficiency Program

Year	Calendar Year	Gross Program-Projected MWh Savings	Net Evaluation Confirmed Program MWh Savings	Gross Program-Projected Peak MW Savings	Evaluation Projected Peak MW Savings**	Gross Program-Projected Therm Savings	Net Evaluation Confirmed Program Therm Savings
1	2004	6,480	3,838	0	0	18,000	46,382
2	2005	6,480	3,838	0	0	18,000	46,382
3	2006	6,480	3,838	0	0	18,000	46,382
4	2007	6,480	3,838	0	0	18,000	46,382
5	2008	6,480	3,838	0	0	18,000	46,382
6	2009	6,480	3,838	0	0	18,000	46,382
7	2010	6,480	3,838	0	0	18,000	46,382
8	2011	6,480	3,838	0	0	18,000	46,382
9	2012	6,480	3,838	0	0	18,000	46,382
10	2013	6,480	3,838	0	0	18,000	46,382
11	2014	6,480	3,838	0	0	18,000	46,382
12	2015	6,480	3,838	0	0	18,000	46,382
13	2016	6,480	3,838	0	0	18,000	46,382
14	2017	6,480	3,838	0	0	18,000	46,382
15	2018	6,480	3,838	0	0	18,000	46,382
16	2019	0	0	0	0	0	0
17	2020	0	0	0	0	0	0
18	2021	0	0	0	0	0	0
19	2022	0	0	0	0	0	0
20	2023	0	0	0	0	0	0
TOTAL	**2004-2023**	97,200.0	57,572.1	-	-	270,000.0	695,729.4

**This program was not expected to provide peak demand savings and none were assessed.

SCG Program Energy Impact Reporting for 2004-2005 Programs

Program ID: 1428-04

Program Name: California Irrigation Technology 2004-2005 Agricultural Pumping Efficiency Program

Year	Calendar Year	Gross Program-Projected MWh Savings	Net Evaluation Confirmed Program MWh Savings	Gross Program-Projected Peak MW Savings	Evaluation Projected Peak MW Savings**	Gross Program-Projected Therm Savings	Net Evaluation Confirmed Program Therm Savings
1	2004	0	0	0	0	58,500	39,577
2	2005	0	0	0	0	58,500	39,577
3	2006	0	0	0	0	58,500	39,577
4	2007	0	0	0	0	58,500	39,577
5	2008	0	0	0	0	58,500	39,577
6	2009	0	0	0	0	58,500	39,577
7	2010	0	0	0	0	58,500	39,577
8	2011	0	0	0	0	58,500	39,577
9	2012	0	0	0	0	58,500	39,577
10	2013	0	0	0	0	58,500	39,577
11	2014	0	0	0	0	58,500	39,577
12	2015	0	0	0	0	58,500	39,577
13	2016	0	0	0	0	58,500	39,577
14	2017	0	0	0	0	58,500	39,577
15	2018	0	0	0	0	58,500	39,577
16	2019	0	0	0	0	0	0
17	2020	0	0	0	0	0	0
18	2021	0	0	0	0	0	0
19	2022	0	0	0	0	0	0
20	2023	0	0	0	0	0	0
TOTAL	**2004-2023**	0	0	0	0	877,500	593,653

**This program was not expected to provide peak demand savings and none were assessed.

SCE Program Energy Impact Reporting for 2004-2005 Programs

Program ID: 1434-04

Program Name: California Irrigation Technology 2004-2005 Agricultural Pumping Efficiency Program

Year	Calendar Year	Gross Program-Projected MWh Savings	Net Evaluation Confirmed Program MWh Savings	Gross Program-Projected Peak MW Savings	Evaluation Projected Net Peak MW Savings**	Gross Program-Projected Therm Savings	Net Evaluation Confirmed Program Therm Savings
1	2004	2,763	959	0	0	0	0
2	2005	2,763	959	0	0	0	0
3	2006	2,763	959	0	0	0	0
4	2007	2,763	959	0	0	0	0
5	2008	2,763	959	0	0	0	0
6	2009	2,763	959	0	0	0	0
7	2010	2,763	959	0	0	0	0
8	2011	2,763	959	0	0	0	0
9	2012	2,763	959	0	0	0	0
10	2013	2,763	959	0	0	0	0
11	2014	2,763	959	0	0	0	0
12	2015	2,763	959	0	0	0	0
13	2016	2,763	959	0	0	0	0
14	2017	2,763	959	0	0	0	0
15	2018	2,763	959	0	0	0	0
16	2019	0	0	0	0	0	0
17	2020	0	0	0	0	0	0
18	2021	0	0	0	0	0	0
19	2022	0	0	0	0	0	0
20	2023	0	0	0	0	0	0
TOTAL	**2004-2023**	41,438	14,388	0	0	0	0

**This program was not expected to provide peak demand savings and none were assessed.

Sum Of Energy Impacts for This 2004-2005 Program

Program IDs*:	1418-04, 1428-04, 1434-04							
Program Name:	California Irrigation Technology 2004-2005 Agricultural Pumping Efficiency Program							
	Year	**Calendar Year**	**Gross Program-Projected MWh Savings**	**Net Evaluation Confirmed Program MWh Savings**	**Gross Program-Projected Peak MW Savings**	**Evaluation Projected Peak MW Savings****	**Gross Program-Projected Therm Savings**	**Net Evaluation Confirmed Program Therm Savings**
	1	2004	9,243	4,797	-	-	76,500	85,959
	2	2005	9,243	4,797	-	-	76,500	85,959
	3	2006	9,243	4,797	-	-	76,500	85,959
	4	2007	9,243	4,797	-	-	76,500	85,959
	5	2008	9,243	4,797	-	-	76,500	85,959
	6	2009	9,243	4,797	-	-	76,500	85,959
	7	2010	9,243	4,797	-	-	76,500	85,959
	8	2011	9,243	4,797	-	-	76,500	85,959
	9	2012	9,243	4,797	-	-	76,500	85,959
	10	2013	9,243	4,797	-	-	76,500	85,959
	11	2014	9,243	4,797	-	-	76,500	85,959
	12	2015	9,243	4,797	-	-	76,500	85,959
	13	2016	9,243	4,797	-	-	76,500	85,959
	14	2017	9,243	4,797	-	-	76,500	85,959
	15	2018	9,243	4,797	-	-	76,500	85,959
	16	2019	-	-	-	-	-	-
	17	2020	-	-	-	-	-	-
	18	2021	-	-	-	-	-	-
	19	2022	-	-	-	-	-	-
	20	2023	-	-	-	-	-	-
	TOTAL	**2004-2023**	138,638	71,960	-	-	1,147,500	1,289,383

*This is the total energy impacts for the program across all IOU territories in which the program was implemented.
**This program was not expected to provide peak demand savings and none were assessed.

5.4 Conclusions and Recommendations

The APEP II program provided a little over two-thirds of the net electric energy impacts expected while exceeding the net therm impacts by 50 percent. They provided 76 percent of the pump tests planned, performing 89 percent of the planned tests in the PG&E service territory, while completing zero tests in the SoCalGas service territory.

For pumps that had been repaired, the average cost to the customer was $16,093 with the incentive averaging 23 percent of the customer's cost.

The empirical evidence of the percent of actual versus expected pumps repairs in PG&E versus SCE service territory seems to indicate that mass media marketing of this type of program is not very successful. Actual face-to-face interactions that took place through the pump tests may have helped increase the visibility of the program and subsequent repairs.

Impact related recommendations:

1. It is recommended that any future pump repair programs should seriously consider the use of personal interactions as the main avenue for marketing the available service.
2. It is recommended that, if natural gas engines are targeted in the future, that the per-repair goal be increased to be more in line with what has been found in the four years of this program. Based on the 17 repairs performed over the past four years, a value of 20,000 therms per repair is recommended.

Assessment of continuing need for program: The evaluation team was tasked with helping to assess whether there is a continuing need for the program. The program's ability to meet its goals was expected to be the measure against which to asses this need. However, there probably should have been two ways of looking at the continuing need for the program: 1) does the market segment continue to need the services provided by this type of program and 2) if so, is this the appropriate implementer to provide those services? The evaluation team answered these two questions using past APEP evaluations and past evaluations of PG&E agricultural programs.

The evaluation of the APEP I program indicated that a main implication for the pump repair decision is the importance of providing program information either through an economic analysis of the pump performance, seminars, or mobile energy center demonstrations. The analysis showed that all these factors have a positive impact on the likelihood that someone will make a change to their pumping system.[8] Results also showed that customers' perceived barriers to obtaining financing were low, but since a significant proportion of customers reported at least some instance of not being able to make a repair or improvement because of a lack of financing, there still appeared to be some barriers faced by customers in this regard.[9] By providing financial assistance in the form of incentives, a program may be able to help mitigate barriers faced by customers relating to obtaining financing. This all points to a continuing need for a program within this sector that provides both information and incentives.

[8] *Evaluation of the Agricultural Pumping Efficiency Program (CPUC #230-02ABCD)*. June 17, 2004. CIT0001.01 on www.CALMAC.org

[9] Ibid.

Moving to the question of whether this implementer is an appropriate company to provide such a program; the APEP I evaluation had confirmed that the program had interactions and synergies with other agencies, created and used mobile energy centers to a positive advantage, provided a smoothly flowing program process, successfully provided pump tests, increased awareness and knowledge of specific efficiency practices, and saved energy. Comparing the four years of the APEP with three years of past PG&E agricultural programs[10] showed that the number of annual repairs within the PG&E service territory were similar for both programs[11] and the average net kWh savings per pump was higher for the APEP programs[12]. From this data, the evaluation team concludes that the CIT would be a knowledgeable and appropriate company to provide similar services in the future.

[10] It is acknowledged that the programs may have been run differently between the two companies. However, comparing the results was considered valid within this context. No analysis of the cost differences to obtain these results was performed.

[11] 84 per year across the PY96, 97, and 98 PG&E programs and 83 per year for the pumps repairs in the PG&E service territory through the APEP programs.

[12] 22,766 net kWh/year/pump for the PG&E programs and 35,985 net kWh/year/pump for the pumps repairs in the PG&E serviced territory through the APEP programs.

APPENDIX A – Flow Meter Report

January 28, 2005

MEMO

To: Pete Canessa, APEP Program Manager
From: Mary Sutter, Equipoise Consulting Inc.

Re: All Quarters 2004 Verification

Summary

This memorandum summarizes Equipoise Consulting's (Equipoise) review of specific tables requested from the Agricultural Pump Efficiency Program (APEP) database. This data assessment is intended to serve two functions. First, it forms a validation of APEP's progress toward attaining its program goals. Second, it allows Equipoise to review the data to assure itself that the data needed for the eventual project evaluation is being collected and entered into the program database. The latter assessment also allows Equipoise to identify, for APEP's benefit, areas of the database that may require attention.

This document covers the two components of the APEP (pump tests and pump repairs). Each component used a sample of the population for verification purposes.

As is presented in Exhibit 1, the verification confirmed 100% of the sample records assessed.

Exhibit 1 - Summary of Verification Results for All Quarters, 2004

Component	Original		Percent of Records Verified	Verified	
	Population (Records)	Sample Size (Records)		Sample	Population
Pump Tests	1,068	89	100%	89	1,068
Pump Repairs	191	65	100%	65	191

Preliminary results indicate that, through the end of the fourth quarter, the program has achieved all of the APEP I gross kWh and Therm impact goals, 1% of its APEP II kWh impact goals, and 18% of the APEP II therm impact goals. These values are not considered final, but provide a preliminary view at how far along the program is in meeting its energy goals.

It is noted here that, through no fault of the program, the mid-2004 verification scheduled for 8/24/04 did not occur. The evaluation team failed to provide the memo. However, this verification covers all pump repairs and pump tests for 2004 (all tests and repair that would have been included in the scheduled verification).

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Details of Assessment

The calculation of the sample size is presented first, followed by the method used in the verification, and then the results of the pump test component and the pump repair component.

Sample Size Determination

Equipoise pulled a sample of records for verification purposes. The sample was pulled using the following assumptions:

- Results of verification would be accurate at the 95th percentile
- Expected percent of valid occurrences in the population set to 90% (conservative value)
- Finite population correction factor used

The following algorithms were used to calculate the sample:

$$nsample = \frac{t^2 * p * (1 - p)}{d^2} \tag{1}$$

$$nfinite = \frac{nsample}{\left(1 + \frac{nsample}{N}\right)} \tag{2}$$

where:

t	=	1.645 (95% confidence level for a one-tailed t-test with infinite degrees of freedom)
p	=	expected percent of valid occurrences in the population (0.9)
d	=	desired level of accuracy (0.05)
N	=	population size
Nsample	=	required sample size without the finite population correction
Nfinite	=	required sample with finite population correction

Verification Method

For each table, all records with the pump test or pump repair data were provided a random value. The records in each of the two tables that fell into the sample frame, as determined by the finite population correction value, were verified.

For the sampled records, Equipoise assessed the total number of cells within each table that contained data, provided a subjective indicator of the importance of the data for both program and evaluation purposes, and subjective comments on the data populating the cells for each variable. An importance level of one (1) indicates that we feel that correct population of these cells is key to either evaluating the project or to documenting the program impacts. An importance level of two (2) indicates that these cells are not key to evaluating or documenting the program.

Once the electronic verification of the data was completed, ten records from the sampled group were randomly selected for visual verification of hardcopy data. The visual verification for the pump tests used 4 items: 1) invoice from the pump tester that is associated with this test, 2) a record with a signature of the recipient that indicated they received the test results, 3) a picture of the test site, and 4) the site access agreement. The visual verification for the pump repair requested five items: 1) application with the signature included, 2) paid invoice and notice of project completion, 3) pre-repair pump test, 4) post-repair pump test, and 5) payment authorization.

Pump Test Component Results

For the pump test portion of the data assessment, Equipoise reviewed the database tables named "tblAPEPPump Tests" in CITTablesEMVQ42004.MDB. A query was used to pull the data from this table that corresponded to records that had the variable "date paid" after 12/31/03 and before 1/1/05. These records were subject to sampling and electronic verification as described above.

This data, however, included multiple pump tests on a single pump. While these tests are listed as multiple tests, they are actually unique "runs" on the same pump conducted during one pump test. The program only pays for a single run per tested pump. Therefore, to calculate the number of unique pump tests that occurred (and were paid for) during the period in question, the query mentioned previously was written so that it pulled only records with relevant dates AND with the "reimburse" variable greater than zero OR with the relevant dates AND the "manualreim" value equal to 1. This narrowed the records to only those tests that had been paid for by the program.

The electronic audit of database variables showed no problems except for two variables that were expected to be 100% filled in with valid data:

- IdealOPE variable had no missing cells, but was populated with zeros 12% of the time; and
- Customer contact variable had a few cells that were blank (97% populated).

Verification of hard copy data requested by Equipoise and received from the APEP was performed in the fourth week of January, 2005.

The verification on the pump tests indicate that 100% of the total number of pump tests claimed have occurred.

This memo provides a paper verification of the pump tests performed in any quarter of 2004. This is the agreed upon process from the research plan for independently verifying the pump tests performed by the APEP.

Pump Repair Component Results

For the pump repair portion of the data assessment, Equipoise reviewed the database table named "tblAPEPProjects" in the database in CITTablesEMVQ42004.MDB. A query was used to pull the data from this table that corresponded to records that had the variable "FirstPayDate" equal to or after 1/1/04 and before 1/1/05. These records were subject to sampling and electronic verification as described above.

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The electronic audit of database variables showed no problems except for two variables that were expected to be 100% filled in with valid data:

- Application Date variable had a missing cell (98% populated), and
- PmpKwhEst variable had multiple cells that were blank (83% populated).

Verification of hard copy data was performed during the fourth week of January, 2005. All projects are considered verified.

Equipoise looked closely at the variables to be used for calculation of energy impacts. The values shown in Exhibit 2 through Exhibit 5 should be considered preliminary and subject to change in the final EM&V report. However, they are included here to provide sense of the progress towards program goals.

Exhibit 2
Estimated kWh Impact through 4th Quarter Verification, 2004 for APEP I

Service Utility	Program Goal (kWh)	Estimated Savings prior to 2004	Estimated Savings in 2004	Estimated Savings in First Half 2005	Estimated Savings in Second Half 2005	Percent of Goal
PG&E	8,150,625	3,185,610	5,803,112	-	-	**110%**
SCE	2,362,500	34,522	1,480,862	-	-	**64%**
SDG&E	504,000	391,603	5,005	-	-	**79%**
Total	**11,017,125**	**3,611,736**	**7,288,979**	-	-	**99%**

Exhibit 3
Estimated Therm Impact through 4th Quarter Verification, 2004 for APEP I

Service Utility	Program Goal (therm)	Estimated Savings prior to 2004	Estimated Savings in 2004	Estimated Savings in First Half 2005	Estimated Savings in Second Half 2005	Percent of Goal
PG&E	42,188	0	81,678	-	-	**194%**
SDG&E	9,000	0		-	-	**0%**
SoCalGas	78,750	0	266,780	-	-	**339%**
Total	**129,938**	**-**	**348,458**	-	-	**268%**

Exhibit 4
Estimated kWh Impact through 4th Quarter Verification, 2004 for APEP II

Service Utility	Program Goal (kWh)	Estimated Savings in 2004	Estimated Savings in First Half 2005	Estimated Savings in Second Half 2005	Percent of Goal
PG&E	4,860,000	56,679	-	-	**1%**
SCE	2,071,875	0	-	-	**0%**
Total	**6,931,875**	**56,679**	**0**	**0**	**1%**

Exhibit 5
Estimated Therm Impact through 4th Quarter Verification, 2004 for APEP II

Service Utility	Program Goal (therm)	Estimated Savings in 2004	Estimated Savings in First Half 2005	Estimated Savings in Second Half 2005	Percent of Goal
PG&E	13,500	0	-	-	**0%**
SoCalGas	43,875	10,232	-	-	**23%**
Total	**57,375**	**10,232**	**0**	**0**	**18%**

As stated previously, this memo provides a paper verification of the program installations through the 4th quarter of 2004. This is the agreed upon process from the research plan for independently verifying the pump repairs performed by the APEP.

Equipoise Consulting   Evaluation & Project Management

June 12, 2006

MEMO

To: Pete Canessa, APEP Program Manager
From: Mary Sutter, Equipoise Consulting Inc.

Re: All Quarters 2005 Verification

Summary

This memorandum summarizes Equipoise Consulting's (Equipoise) review of specific tables requested from the Agricultural Pump Efficiency Program (APEP) database. This data assessment was intended to serve two functions. First, it formed a validation of APEP's progress toward attaining its program goals. Second, it allowed Equipoise to review the data to assure itself that the data needed for the eventual project evaluation is being collected and entered into the program database. The latter assessment also allowed Equipoise to identify, for APEP's benefit, areas of the database that may require attention. For this current verification, the second goal is moot since this is the final verification of the program and all data required for the analysis was included in the latest database.

This document covers the two components of the APEP (pump tests and pump repairs). Each component used a sample of the population for verification purposes.

As is presented in Exhibit 1, the verification confirmed 100% of the sample records assessed.

Exhibit 1 - Summary of Verification Results for All Quarters, 2005

Component	Original		Percent of Records Verified	Verified	
	Population (Records)	Sample Size (Records)		Sample	Population
Pump Tests	1,244	90	100%	90	1,244
Pump Repairs	115	53	100%	53	115

Details of Assessment

The calculation of the sample size is presented first, followed by the method used in the verification, and then the results of the pump test component and the pump repair component.

Sample Size Determination

Equipoise pulled a sample of records for verification purposes. The sample was pulled using the following assumptions:

- Results of verification would be accurate at the 95th percentile

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- Expected percent of valid occurrences in the population set to 90% (conservative value)
- Finite population correction factor used

The following algorithms were used to calculate the sample:

$$nsample = \frac{t^2 * p * (1 - p)}{d^2} \qquad (1)$$

$$nfinite = \frac{nsample}{\left(1 + \frac{nsample}{N}\right)} \qquad (2)$$

where:

t	=	1.645 (95% confidence level for a one-tailed t-test with infinite degrees of freedom)
p	=	expected percent of valid occurrences in the population (0.9)
d	=	desired level of accuracy (0.05)
N	=	population size
Nsample	=	required sample size without the finite population correction
Nfinite	=	required sample with finite population correction

Verification Method

For each table, all records with the pump test or pump repair data were provided a random value. The records in each of the two tables that fell into the sample frame, as determined by the finite population correction value, were verified.

For the sampled records, Equipoise assessed the total number of cells within each table that contained data, provided a subjective indicator of the importance of the data for both program and evaluation purposes, and subjective comments on the data populating the cells for each variable. An importance level of one (1) indicates that we feel that correct population of these cells is key to either evaluating the project or to documenting the program impacts. An importance level of two (2) indicates that these cells are not key to evaluating or documenting the program.

Once the electronic verification of the data was completed, ten records from the sampled group were randomly selected for visual verification of hardcopy data. The visual verification for the pump tests used 4 items: 1) invoice from the pump tester that is associated with this test, 2) a record with a signature of the recipient that indicated they received the test results, 3) a picture of the test site, and 4) the site access agreement. The visual verification for the pump repair requested five items: 1) application with the signature included, 2) paid invoice and notice of project completion, 3) pre-repair pump test, 4) post-repair pump test, and 5) payment authorization.

Pump Test Component Results

For the pump test portion of the data assessment, Equipoise reviewed the database tables named "tblAPEPPumpTest0328" in tblAPEPProjects032806.MDB. A query was used to pull the data from this table that corresponded to records that had the variable "date paid" after 12/31/04 and were part of the APEP II. These records were subject to sampling and electronic verification as described above.

This data, however, included multiple pump tests on a single pump. While these tests are listed as multiple tests, they are actually unique "runs" on the same pump conducted during one pump test. The program only pays for a single run per tested pump. Therefore, to calculate the number of unique pump tests that occurred (and were paid for) during the period in question, the query mentioned previously was written so that it pulled only records with relevant dates AND with the "reimburse" variable greater than zero. This narrowed the records to only those tests that had been paid for by the program.

The electronic audit of database variables showed no problems for the high priority variables except for one variables that was expected to be 100% filled in with valid data. The IdealOPE variable had no missing cells, but was populated with zeros 2% of the time. This was an improvement over the last verification in which 12% of the records showed a zero value.

Verification of hard copy data requested by Equipoise and received from the APEP was performed in the first week of June, 2006.

The verification on the pump tests indicate that 100% of the total number of pump tests claimed have occurred.

This memo provides a paper verification of the pump tests performed in any quarter of 2005. This is the agreed upon process from the research plan for independently verifying the pump tests performed by the APEP.

Pump Repair Component Results

For the pump repair portion of the data assessment, Equipoise reviewed the database table named "tblAPEPProjects0328" in the database in tblAPEPProjects032806.MDB. All records in this table were pulled into Excel and those APEP II records paid in 2005 were determined. These records were subject to sampling and electronic verification as described above.

The electronic audit of database variables showed no problems in the high priority variables except for three variables that were expected to be 100% filled in with valid data:

- Account variable had one missing cell (98% populated),
- Pump location had 48 of the 53 records filled in (91% populated), and
- OPENow variable had one cell that was blank (98% populated). However, this was not an issue for the analysis as the kWh/AF value for both pre- and post-repair were present.

The missing data did not adversely effect the impact analysis. Verification of hard copy data was performed during the first week of June, 2006. All projects are considered verified.

As stated previously, this memo provides a paper verification of the program installations through the 4th quarter of 2005. This is the agreed upon process from the research plan for independently verifying the pump repairs performed by the APEP.

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APPENDIX B – Verification Memos

Equipoise Consulting, Inc.

Evaluation

Project Management

Final Report for

Evaluation of Flow Meters in California

(Part of the Evaluation of the California Irrigation Technology 2004-2005 Agricultural Pumping Efficiency Program - CPUC Project Number 1418-04, 1428-04, 1434-04)

Submitted by:

Equipoise Consulting Incorporated

In association with

Vanward Consulting

Ridge & Associates

And California AgQuest Consulting Inc,

September 8, 2005

Equipoise Consulting Incorporated is committed to environmentally friendly practices in the workplace. We use recycled paper in all our proposals and reports. We print double sided and use electronic faxes when possible to decrease paper use. All our office paper is recycled. Our distributed office arrangement means that work between colleagues is performed by telecommuting, thereby minimizing environmental transportation impacts.

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1 Executive Summary

In 2002, the CSU Foundation California Irrigation Technology (CIT) Agricultural Pumping Efficiency Program (APEP-I) was awarded funding from the California Public Utilities Commission (CPUC) to provide an education and incentive-based energy efficiency program. The APEP-I program began in October of 2002 and will continue through December 2005[1]. The program was re-funded for program years (PY) 2004 and 2005 with the name APEP-II. APEP-II will run from March 2004 through December 2005. While the two programs will overlap, the accounting will be separate. APEP-I was evaluated with a final report dated June 17, 2004. An evaluation errata report will follow up on the APEP-I after its completion in December 2005 that will cover only the measures under the PY2002-2003 program.

The evaluation team of Equipoise Consulting Inc., California AgQuest Consulting Inc, Ridge & Associates, and Vanward Consulting (the Team) performed the assessment of the APEP-I program and is providing two reports for the APEP-II evaluation. This first report delves into the use of flow meters and attempts to determine if there are relationships between the use of a flow meter and energy efficient actions. Since flow meters are not part of the current program, the report investigates a program design issue. The second report (due March 2006) will provide a background of the program and energy impacts associated with the pump repairs performed by the program.

In the evaluation of the APEP-I, the Program was found to be working well and successfully. Because of these findings and the feeling that simply reiterating the previous evaluation would be redundant and not a good use of evaluation funds, the evaluation team decided to look into areas of the program where evaluation research could enhance future program design. After discussions among the evaluation team members, the program manager, and the CPUC Energy Division Master Contractor, water flow meter use in agricultural pumping emerged as an area that had the potential to increase energy efficient use of a pump. Fourteen hypotheses were generated and tested about the adoption of flow meters or the effect of adopting flow meters. More specifically, it was posited that a flow meter would increase the persistence of the educational message regarding appropriate water use by continually reinforcing the information initially provided by a pump test. Regular observation of the pump flow rate could provide the information to catch early indications of wear on a pump that cause inefficiencies and increased energy use. Additionally, knowledge of the output of a newly repaired pump could increase growers' confidence that the correct water amount is used for the crop, resulting in both water and energy savings at the pump.

Telephone interviews were conducted with 125 APEP-I or APEP-II participants who have flow meters installed on at least some of their pumps and 125 APEP-I or APEP-II participants who have no flow metes installed on any of their pumps. In addition to collecting basic firmographics information about each farming operation, additional information such as levels of awareness about water energy used by their pumps, the adoption of a wide variety of energy efficient hardware and behavior, as well as other pump-related behavior was collected.

[1] The extension of the program was allowed through Ruling CPUC01-#192772_v1_R0108028_KLM_Ruling, 4/18/05.

1.1 Results

A variety of analyses were carried out that lead to the following conclusions regarding the strong, moderate, weak, or no support for the hypotheses tested. Exhibit 1.1 summarizes these results.

Exhibit 1.1
Summary of Findings Regarding Hypotheses

No.	Hypothesis	None	Weak	Moderate	Strong
1	Growers who install flow meters are more aware of the water and energy used by their pumps.	X (Energy)		X (Water)	
2	Increased awareness of water flow rates causes a grower to change their irrigation management or other pumping system related behavior.	X (Energy)	X (Water)		
3	Cost is a major barrier to the installation of flow meters. (i.e., installing piping to obtain accurate reading of the flow of the water).				X
4	Growers who install flow meters are more likely to make changes to their irrigation management or other pumping system related behavior.		X		
5	Growers who believe that a flow meter can reduce operating costs are more likely to install a flow meter.				X
6	Growers who are confident in the accurate reading of the flow meter will be more likely to change their irrigation management or other pumping system related behavior.		X		
7	Growers who understand how to interpret the changes of flow meter readings are more likely to investigate how to maintain the efficiency of the pump or the irrigation system.	X			
8	Growers who investigate how to maintain the efficiency of the pump or the irrigation system are more likely to change their irrigation management or other pumping system related behavior.		X (Energy)	X (Water)	
9	Growers who investigate how to maintain the efficiency of the pump or the irrigation system are more likely to make hardware changes that improve the efficiency of their pumping system.			X (Water & Energy)	
10	Growers who install flow meters are more likely to make hardware changes that improve the efficiency of their pumping system.	X			
11	Increased awareness of water and energy use causes a grower to make hardware changes that improve the efficiency of their pumping system.		X (Water & Energy)		

No.	Hypothesis	None	Weak	Moderate	Strong
12	Growers who are confident in the accurate reading of the flow meter will be more likely to make hardware changes that improve the efficiency of their pumping system.	X			
13	Growers who understand how to interpret the changes of flow meter readings are more likely to change their irrigation management or other pumping system related behavior.	X			
14	Growers who understand how to interpret the changes of flow meter readings are more likely to make hardware changes that improve the efficiency of their pumping system.	X			

* There were 19 hypotheses tested since five of the hypotheses (1, 2, 8, 9, and 11) had both a water and an energy component that were tested separately.

For the 19 hypotheses tested, there was no support for 7, weak support for 6, moderate support for 4, and strong support for 2.

Hypotheses 4 and 10 were considered primary since, if the benefits of flow meters could not be established, then factors that increase their adoption and use are of little interest. However, there was only weak support for Hypothesis 4 and no support for Hypothesis 10.

1.1.1 Recommendations

Based on these analyses, it appears premature to recommend that a full educational component focusing on flow meters be added to the APEP or to provide incentives for the purchase of flow meters. However, the weak support for Hypothesis 4 along with the survey results support continuing to educate growers about flow meters. Growers tend to identify with potential water savings that can be associated with information from flow meters since water applications have a direct relationship to the performance and yields of corps. Energy used to provide the water is one step removed from the growth of crops. Therefore, educational efforts must be much more intensive in the use of flow meter information to better manage and reduce energy use through management of water use since grower do not have a “mind-set” that relates energy use to crop production. Based on the analysis of the other hypotheses, education materials should stress that the installation of flow meters can reduce operating costs. This is particularly important since cost is one of the major barriers to the installation of flow meters and reduced operating costs can help to reduce the payback on such a purchase. In addition, these materials could also stress that there are a large number of behavioral and hardware changes that can be better informed using information provided by flow meters. Finally, water use appears to be a more important factor than energy use in the decision to install flow meters. Therefore, while not ignoring the energy benefits, stressing in these educational materials the reduction of water use is recommended.

2 Introduction

In 2002, the CSU Foundation California Irrigation Technology (CIT) Agricultural Pumping Efficiency Program (APEP-I) was awarded funding from the California Public Utilities Commission (CPUC) to provide an education and incentive-based energy efficiency program. The APEP-I program began in October of 2002 and will continue through December 2005[2]. The program was re-funded for program years (PY) 2004 and 2005 with the name APEP-II. APEP-II will run from March 2004 through December 2005. While the two programs will overlap, the accounting will be separate. APEP-I was evaluated with a final report dated June 17, 2004. An evaluation errata report will follow up on the APEP-I after its completion in December 2005 that will cover only the measures under the PY2002-2003 program.

The evaluation team of Equipoise Consulting Inc., California AgQuest Consulting Inc, Ridge & Associates, and Vanward Consulting (the Team) performed the assessment of the APEP-I program and is providing two reports for the APEP-II evaluation. This first report delves into the use of flow meters and attempts to determine if there are relationships between the use of a flow meter and energy efficient actions. Since flow meters are not part of the current program, the report investigates a program design issue. The second report (due March 2006) will provide a background of the program and energy impacts associated with the pump repairs performed by the APEP-II program.

2.1 CPUC Stipulated Items

The CPUC has required that a set of eight overall objectives as well as specific EM&V components for the pump repairs be addressed in each evaluation. In this section, the eight objectives are listed and a description of the response to each is shown by:

1. referring to the appropriate section of the report that addresses the objective, or
2. stating that, given the nature of the program or the existence of a study that already addresses the objective, the objective is not relevant to this particular evaluation.

Exhibit 2.1
Meeting the CPUC Stipulated Objectives

CPUC Objective	*How evaluation will meet objective*
Measuring level of energy and peak demand savings achieved. (except information-only)	*The Equipoise Team will use IPMVP Option A to measure the energy impact of the program. No peak demand impacts are expected and peak demand savings will not be assessed. The results of this assessment will be included in the Impact Report for APEP-II (March 2006).*
Measuring cost-effectiveness (except information-only)	*The evaluation will use a semi-annual verification process to track pump tests and pump repairs. The results of this assessment will be included in the Impact Report for APEP-II (March 2006).*

[2] The extension of the program was allowed through Ruling CPUC01-#192772_v1_R0108028_KLM_Ruling, 4/18/05.

CPUC Objective	***How evaluation will meet objective***
Providing up-front market assessments and baseline analysis, especially for new programs	*Since a market assessment was completed in 1998 and a market needs study was completed in 2000, a market assessment or baseline analysis will not be done as a part of this evaluation. The pump test and pump repair market is not suspected to have changed radically since these studies.*
Providing ongoing feedback and corrective and constructive guidance regarding the implementation of programs.	*The Team was in contact both orally and via email with the program manager as needed throughout the evaluation period.*
Measuring indicators of the effectiveness of specific programs, including testing of the assumptions that underlie the program theory and approach.	*The program theory was created in the evaluation of APEP-I. As the APEP-II is implemented identically, there was no need to adjust the theory. The majority of the assumptions underlying the theory were assessed and reported upon in the APEP-I Report (6/2004). No further testing of theory occurred in this evaluation.*
Assessing the overall levels of performance and success of programs.	*The Team will assess the extent to which the Program achieved its stated objectives through the measurement and verification of pump tests and pump repairs. The results of this assessment will be included in the Impact Report for APEP-II (March, 2006).*
Informing decisions regarding compensation and final payments.	*The Team will track the total kWh impact in comparison to the planned kWh objectives for the program and provide this data as needed to the Program Implementer and/or CPUC to inform decisions regarding compensation and final payments. The results of this assessment will be included in the Impact Report for APEP-II (March, 2006).*
Helping to assess whether there is a continuing need for the program.	*The Team will use all the information gathered during this evaluation to help assess the need for this Program in the future. Specifically, if the program implementer meets the overall program energy and education goals, it will be assumed that the program was able to market their program effectively, that there was a desire for their services within the agricultural and pumping population, and that the program should be continued. The results of this assessment will be included in the Impact Report for APEP-II (March, 2006).*

2.2 Outline of Report

Section 3 provides the analysis method used for the evaluation, sample design, and data collection. Section 4 gives the results of the assessment, comparing those who have flow meters and those who do not, information about those who use flow meters, and results by each study hypothesis. Section 5 summarized these results into findings and provides recommendations based on those findings.

Appendices provide the reference section, the survey instrument, frequencies of all survey responses, a data dictionary, and the detailed results from the final regression models used to test the various hypotheses.

3 Study Method

In the evaluation of the APEP-I, the program was found to be working well and to be a successful program. Because of these findings and the feeling that simply reiterating the previous evaluation would be redundant and not a good use of evaluation funds, the evaluation team decided to look into areas of the program where evaluation research could enhance future program design. After discussions among the evaluation team members and the program manager, water flow meter use in agricultural pumping emerged as an area that had the potential to increase energy efficient use of a pump. At the same time, little was known about how flow meters are currently used in the field or whether the growers would accept them as an energy efficiency measure. The concept of researching these issues was discussed with the CPCU Energy Division's Master Contractor and the approach agreed upon between the two parties. The next section outlines the hypotheses that the team assessed in this evaluation.

3.1 Evaluation Overview and Hypotheses

The state of California has close to nine million acres of irrigated land[3]. It has over 87% of pumps that are powered by electricity, leading to one of the highest energy costs per irrigated acre in the country.[4] APEP-I and APEP-II programs use both education and incentives to target a reduction in the cost at the pump for the grower through creating an energy efficient pump. There are four areas upon which the educational portion of the program focuses. The first two parts of the message deal with specifics of the pump while the latter two parts of the message cover water needs. The amount of water used on a crop is an essential piece of knowledge for the grower. Too little and the crops do not produce the optimum yield, too much and the energy use at the pump is not ideal. However, according to the over 4,000 pump tests and over 150 pump repairs performed in APEP-I, only about 21% of the pumps have flow meters that would provide necessary data on a continuous basis to the grower on water use. The pump tests provided by the program gives the grower a snapshot of water flow (in gallons per minute, GPM) and energy use for the water use (kWh per acre-foot of water) at the time of the pump test; whereas a flow meter would provide relevant information to the grower on an ongoing basis.

It was posited that a flow meter would increase the persistence of the educational message regarding appropriate water use by continually reinforcing the information initially provided by a pump test. Regular observation of the pump flow rate could provide the information to catch early indications of wear on a pump that cause inefficiencies and increased energy use. Additionally, knowledge of the output of a newly repaired pump could help the grower's assurance that the correct water amount is used for the crop, resulting in both water and energy savings at the pump. However, these assumptions were untested. There is much that is not known about the use of a flow meter in the pumping system and the potential behavioral changes that could occur with a flow meter and effect energy use. Therefore the evaluation team performed primary research targeted toward testing the hypotheses indicated in Exhibit 3.1.

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[3] *Table 9. Land in Farms, Harvested Cropland, and Irrigated Land, by Size of Farm: 2002 and 1997.* 2002 Census of Agriculture – State Data. Downloaded from http://www.nass.usda.gov/census/census02/volume1/ca/index1.htm.

[4] *Latest Farm and Ranch Survey Reveals Pulse of Irrigation.* Irrigation Business & Technology. November, 1999. On-line Edition.

Exhibit 3.1
Original Flow Meter Research Hypotheses

No.	Hypothesis
1	Growers who install flow meters are more aware of the water *and* energy used by their pumps.
2	Increased awareness of water flow rates *and* energy use causes a grower to change their irrigation management or other pumping system related behavior.
3	Cost is a major barrier to the installation of flow meters. (i.e., installing piping to obtain accurate reading of the flow of the water).
4	Installation of a flow meter causes growers to change their irrigation management or other pumping system related behavior.
5	Growers who believe that a flow meter can reduce operating costs are more likely to install a flow meter.
6	Growers who are confident in the accurate reading of the flow meter will be more likely to change their irrigation management or other pumping system related behavior.
7	Growers who understand how to interpret the changes of flow meter readings are more likely to investigate how to maintain the efficiency of the pump or the irrigation system.
8	Growers who investigate how to maintain the efficiency of the pump or the irrigation system with respect to water *and* energy use are more likely to change their irrigation management or other pumping system related behavior.

After considering the specific hypotheses in greater detail and determining to investigate more specific details about flow meter use and their impacts, the evaluation team refined the study hypotheses as noted in Exhibit 3.2 below. The hypotheses indicated here were used to develop the survey instrument presented in Appendix B and tested using the regression models presented in Appendix D and later discussed in Section 4 of this report.

Exhibit 3.2
Final Flow Meter Research Hypotheses

No.	Hypothesis
1	Growers who install flow meters are more aware of the water *and* energy used by their pumps.
2	Increased awareness of water flow rates *and* energy use causes a grower to change their irrigation management or other pumping system related behavior.
3	Cost is a major barrier to the installation of flow meters. (i.e., installing piping to obtain accurate reading of the flow of the water).
4	Growers who install flow meters are more likely to change their irrigation management

No.	Hypothesis
	or other pumping system related behavior.
5	Growers who believe that a flow meter can reduce operating costs are more likely to install a flow meter.
6	Growers who are confident in the accurate reading of the flow meter will be more likely to change their irrigation management or other pumping system related behavior.
7	Growers who understand how to interpret the changes of flow meter readings are more likely to investigate how to maintain the efficiency of the pump or the irrigation system.
8	Growers who investigate how to maintain the efficiency of the pump or the irrigation system with respect to water and energy use are more likely to change their irrigation management or other pumping system related behavior.
The following 6 hypotheses were added after the final research plan.	
9	Growers who investigate how to maintain the efficiency of the pump or the irrigation system with respect to water and energy use are more likely to make hardware changes that improve the efficiency of their pumping system.
10	Growers who install flow meters are more likely to make hardware changes that improve the efficiency of their pumping system.
11	Increased awareness of water *and* energy use causes a grower to make hardware changes that improve the efficiency of their pumping system.
12	Growers who are confident in the accurate reading of the flow meter will be more likely to make hardware changes that improve the efficiency of their pumping system.
13	Growers who understand how to interpret the changes of flow meter readings are more likely to change their irrigation management or other pumping system related behavior.
14	Growers who understand how to interpret the changes of flow meter readings are more likely to make hardware changes that improve the efficiency of their pumping system.

Note that five of the hypotheses (1, 2, 8, 9, and 11) involve both a water use component and an energy use component. For these hypotheses, separate models for the water use component of the hypothesis and separate models for the energy use component of the hypothesis were estimated. Thus, counting these sub-hypotheses, 19 hypotheses were tested overall.

As the hypotheses imply, the evaluation needed to survey growers both with and without flow meters. The best approach to this analysis would have been to obtain all the pumping accounts in the three service territories covered by APEP-II and separate them into strata by energy use. Past agricultural evaluations have indicated differences in operating practices based on size of a company. The surveys could then be stratified by annual usage to provide efficient estimates for the population. However, due to the difficulty in obtaining customer contact and energy use data from the utilities, this approach could not be used for the evaluation.

Therefore, the evaluation used participants in APEP-I and APEP-II as the population for our survey. Restricting surveys to past program participants means that the ultimate results are not generalizable to the entire agricultural population.

3.2 Analysis Methods

The telephone surveys of those who installed a flow meter and telephone surveys of those who did not install a flow meter were required to test the hypotheses listed in Exhibit 3.2. Multiple approaches were used to analyze the hypotheses as shown in Exhibit 3.3.

All of the analyses began with descriptive statistics characterizing both the installers and the non-installers. This was followed by bivariate analyses (analyses involving only two variables, a dependent variable and an independent variable assumed to explain variation in the dependent variable). These analyses were conducted using t tests and chi-square. Finally, statistical models involving multiple variables were employed. These more complex analyses were conducted using logistic regression models and/or ordinary least squares regression models[5] and are described in Section 3.2.1.

Exhibit 3.3
Flow Meter Research Hypotheses, by Group(s) Used to Test these Hypotheses

No.	Hypothesis	Groups (Installers/Non-Installer/Both)
1	Growers who install flow meters are more aware of the water *and* energy used by their pumps.	Both
2	Increased awareness of water flow rates *and* energy use causes a grower to change their irrigation management or other pumping system related behavior.	Both
3	Cost is a major barrier to the installation of flow meters. (i.e., installing piping to obtain accurate reading of the flow of the water).	Non-Installers
4	Growers who install flow meters are more likely to change their irrigation management or other pumping system related behavior.	Both
5	Growers who believe that a flow meter can reduce operating costs are more likely to install a flow meter.	Both
6	Growers who are confident in the accurate reading of the flow meter will be more likely to change their irrigation management or other pumping system related behavior.	Installers
7	Growers who understand how to interpret the changes of flow meter readings are more likely to investigate how to maintain the efficiency of the pump or the irrigation system.	Installers
8	Growers who investigate how to maintain the efficiency of the pump or the irrigation system with respect to water *and* energy use are more likely to change their irrigation management or other pumping	Both

[5] The third hypothesis was tested by surveying the non-installers to determine the extent to which cost was a barrier. A sample size of 120 provided estimates at the 90 percent level of confidence +/- 0.055.

No.	Hypothesis	Groups (Installers/Non-Installer/Both)
	system related behavior.	
9	Growers who investigate how to maintain the efficiency of the pump or the irrigation system with respect to water *and* energy use are more likely to make hardware changes that improve the efficiency of their pumping system.	Both
10	Growers who install flow meters are more likely to make hardware changes that improve the efficiency of their pumping system.	Both
11	Increased awareness of water *and* energy use causes a grower to make hardware changes that improve the efficiency of their pumping system.	Both
12	Growers who are confident in the accurate reading of the flow meter will be more likely to make hardware changes that improve the efficiency of their pumping system.	Installers
13	Growers who understand how to interpret the changes of flow meter readings are more likely to change their irrigation management or other pumping system related behavior.	Installers
14	Growers who understand how to interpret the changes of flow meter readings are more likely to make hardware changes that improve the efficiency of their pumping system.	Installers

Two sub-models were developed to illustrate graphically the hypothesized cause and effect relationships listed in Exhibit 3.3. Exhibit 3.4 illustrates those relationships that were tested using both installers and non-installers while Exhibit 3.5 illustrates those relationships that were tested using only installers. The numbers assigned to the linkages correspond with the hypotheses in Exhibit 3.3

Exhibit 3.4
Hypotheses Involving Installers and Non-Installers

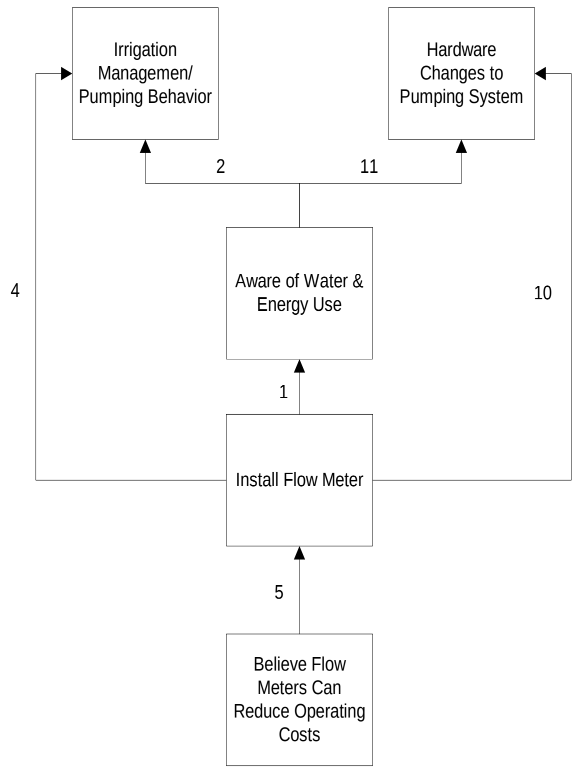
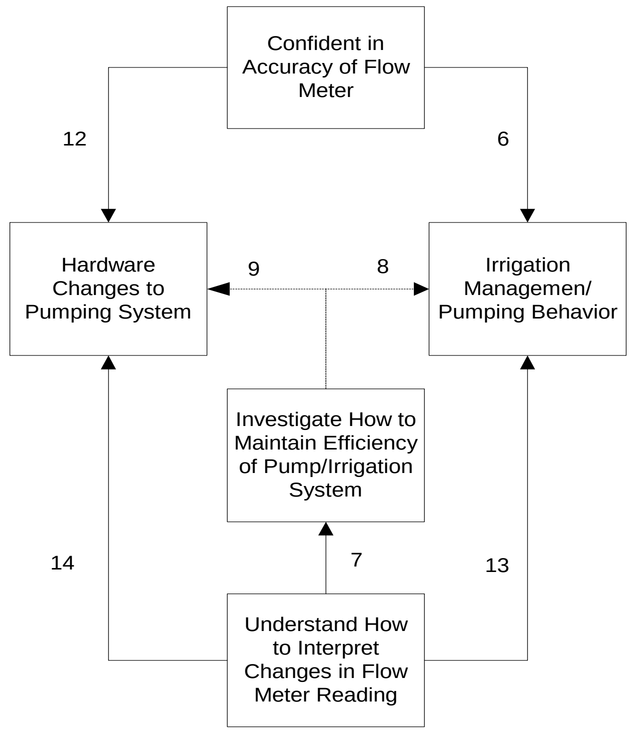


Exhibit 3.5
Hypotheses Involving Only Installers



3.2.1 Logistic Regression

For models in which the dependent variable was binary, logistic regression models were employed. The general form of the logit model is provided below with the model statistics for the various estimated models provided in Appendix E.

$$P_{r_i} = \frac{e^{\sum_{k=1}^{K} \beta_k x_k}}{1 + e^{\sum_{k=1}^{K} \beta_k x_k}} \qquad (1)$$

where

P_{r_i} = the probability associated with choosing the desired option specific to each hypothesis for the k^{th} customer

X_k = the vector of explanatory variables corresponding to the k^{th} customer

β = the vector of estimated coefficients that maximizes P_{ri}.

In these logistic regression models, there were three basic types of independent variables: 1) binary variables, 2) interval variables, and 3) variables that represent the interaction of a binary variable and an interval variable. Typically, the dependent variable on the key independent variable of interest was regressed while attempting to control statistically for other variables such as type of irrigation system, type of farm operation, levels of awareness of energy and water use, and ownership.

3.2.2 OLS Regression

For models in which the dependent variable was at the ordinal or interval level of measurement, ordinary least squares was used. The general form of the ordinary least squares (OLS) regression models is presented in Equation 2.

$$Y = \alpha + \lambda Z + \sum_{k=1}^{n} \beta_j X_k \qquad (2)$$

where

Y=	The dependent variable for a given hypothesis
$\alpha =$	The intercept (the predicted value of the dependent variable when all variables in the model are set to zero)
$\lambda =$	The coefficient associated with the key independent variable for a given hypothesis, which reflects the change in the dependent variable, associated with a one-unit change after controlling for the effects of all other variables in the model.
$Z =$	The key independent variable associated with a given hypothesis
$\beta_j =$	A vector of j coefficients that reflect the change in the dependent variable associated with a one-unit change in the j^{th} explanatory variables.
$X_k =$	A vector of other explanatory variables, such as size of farm, number of years in business, and awareness of water use of pump for the k^{th} customer

In these OLS regression models, there were three basic types of independent variables: 1) binary variables, 2) interval variables, and 3) variables that represent the interaction of a binary variable and an interval variable. Typically, the dependent variable on the key independent variable of interest was regressed while attempting to control statistically for other variables such as type of irrigation system, type of farm operation, levels of awareness, and ownership.

Note that the OLS approach was also used as an exploratory tool that could obtain a very quick sense of the data and some of the relationships. For *all* the hypotheses regardless of whether the dependent variable was binary, ordinal, or interval, the stepwise method was used as an exploratory tool with the threshold for entry into the model set at the 0.20 level of statistical significance and the threshold for remaining in the model set at the 0.21 level of significance. This exploratory analysis provided valuable insights into data coding and model specification issues.

3.2.3 Available Variables for Regression Models

When the installers and non-installers were analyzed, the following 33 variables were available:

1. Number of pumps used in operation
2. Presence of flow meters
3. Percent of pumps with working flow meters
4. Size of farming operation
5. Source of revenue for the farm (e.g., vegetable/file crops, dairy farm, orchard, etc.)
6. Portion of land owned
7. Type of irrigation system
8. Ownership (family, company, government entity)
9. Age of water pumps
10. Length of time at current location
11. Importance of being sure that pumping system makes efficient use of energy
12. Importance of being sure that pumping system makes efficient use of water
13. Awareness of the amount of water used by pumps
14. Awareness of the amount of energy used by pumps
15. The presence of established practices for maintaining the pumping system
16. The presence of established practices for maintaining the irrigation system other than the pumping system
17. Confidence that flow meters can assist growers to reduce the operating costs of their pumps
18. Whether respondent has installed and used tools or instruments to measure soil moisture in the filed
19. Whether respondent has converted from surface to drip or sprinkler irrigation for some or all irrigations during the season
20. Whether the respondent has converted from open ditch to gated pipe or sprinkler irrigation
21. Whether the respondent has changed hardware configurations based on an irrigation system evaluation.
22. Whether the respondent installs additional pressure gauges at equipment stations for drip or sprinkler systems
23. Whether respondent replaces or rebuilds the bowls on deep-well pumps
24. Whether the respondent regularly adjusts the bowls on deep-well pumps
25. Whether respondent determines how much water to apply for an irrigation using soil, plant, or weather-based measurements.
26. Whether respondent measures the soil moisture in a filed after irrigations to determine how effective they were.
27. Whether respondent, for drip or micro-sprinkler systems, cleans and replaces defective emitters or sprinklers at least once per year.

28. Whether respondent, for impact sprinkler systems, replaces worn nozzles at least once per year and uses a mid-filed mainline placement during the season.
29. Whether respondent, for drip and sprinkler systems, regularly monitors and adjusts system pressures, cleans in-line screens, and flushes lines at least once a year
30. Whether respondent, for surface irrigation systems, shortens run lengths and/or converts from open ditches to gated pipe
31. Whether respondent has begun to grow crops that use less water
32. Whether respondent monitors pump flow rates with a flow meter for significant changes
33. Whether respondent monitors total water pumped by recording the total reading on a flow meter.

When analyzing only the installers, the following additional variables were available:

1. Confidence that the information provided by flow meters is accurate
2. Confidence in their ability to interpret changes in the readings from a flow meter

3.2.4 Regression Diagnostics

The robustness of the models was validated by performing a variety of diagnostic checks referred to in the Quality Assurance Guidelines (Ridge et al., 1994). In the logistic models, checks were conducted for outliers and multicollinearity using methods described by Kennedy (1992), Belsey et al. (1980), and Hosmer and Lemeshow (1989).

3.2.5 Hypothesis Testing

The analysis used to test the 19 hypothesis often involved more than one method and more than one model. Exhibit 3.6 presents the number of analyses, by analysis type and hypothesis.

Exhibit 3.6
Number of Analyses, by Analysis Type and Hypothesis

	Analysis Type			
Hypothesis	**Logistic**	**OLS**	**Bivariate**	**Survey**
1*	7	2		
2*	14	2		
3				1
4	7	1	7	7
5	1			
6 & 13	7	1		
7	2			
8*	14	2		
9*	14	2		
10	7	1	7	7
11*	14	2		
12 & 14	7	1		
Total	94	14	14	15

* Hypotheses that were tested separately for water and energy use.

For example, in order to test Hypothesis 1, two ordinary least squares (OLS) models were estimated, one in which awareness of water use was the dependent variable and one in which awareness of energy use was the dependent variable. Or, in order to test Hypotheses 4, seven logistic regression models and one OLS regression model was estimated, seven bivariate analyses (Chi-squares) were conducted, and the responses to seven survey questions about the influence of the flow meter on changes to their irrigation management or other pumping system related behaviors were examined.

When forming the final conclusions regarding each hypothesis, the results of the logistic models and OLS regression models were the primary pieces of information relied upon. For Hypothesis 4 and 10, the results of the bivariate analyses, and the survey responses were also taken into account. For a given hypothesis, the results of all the analyses in arriving at the conclusions regarding the level of support were considered. In such situations, there are no hard-and-fast rules about what constitutes strong, moderate, weak, or no support for a given hypothesis. For example, for the models in which changes in behaviors and hardware were the dependent variables, one logistic model for each behavior was estimated as was one OLS model in which the sum of all the behavioral or hardware changes was the dependent variable. When none of the models produced statistically significant results, the conclusion was that there was no support for the hypothesis. When one of the models produced statistically results, the conclusion was that the support was weak. However, in more complicated situations in which more than one of the models produced statistically significant results that were a mix of weak, medium or strong support, the best judgment of the evaluation team was used to determine the final level of support for the hypothesis.

3.2.6 Sample Design

The sample sizes were determined using power analysis (Borenstein and Cohen, 1988; Cohen, 1988; Kraemer, Chmura, and Thiemann, 1987; Lipsey, 1990). The power of a statistical test of a null hypothesis is the probability that it will lead to a rejection of the null hypothesis when it is false, i.e., the probability that it will result in the conclusion that the phenomenon exists.

For hypotheses involving both installers and non-installers, the maximum sample size was 250. When testing hypotheses involving only one group, the maximum sample size was 125. The sample sizes were based on some general assumptions made about explained variance due to the *covariates* and the increment to explained variance due to the *treatment*, the key variable(s) of interest in testing a given hypotheses. When both groups (installers of flow meters and non-installers of flow meters) were involved, it was assumed that the anticipated model would include 10 covariates or control variables, which will yield an R-squared of 0.250. It was further assumed that the model would include the treatment variables of interest, which would yield an increment of 0.030 in the R-squared. The total R-squared for the 12 variables in the model was assumed to be 0.280. The effect size (0.03/0.25) of 0.12 is considered by Cohen (1988) to be medium. The power analysis focuses on the increment for the treatment variables of interest over and above any prior variables (i.e. 2 variables yielding an increment of 0.03). This effect was selected as the smallest effect that would be important to detect, in the sense that any smaller effect would not be of clinical or substantive significance.

With the given sample size of 250 and alpha set at .05 the study will have statistical power of 0.80, the generally accepted threshold (Cohen, 1988). This means that an analyst would have an 80 percent probability of detecting a treatment effect if there really is one. When one group is involved, the maximum sample is only 125. This smaller sample size, all other things being equal, reduces the statistical power from 0.80 to 0.50. That is, an analyst would have only a 50 percent probability of detecting a treatment effect if there really is one.

3.2.7 Data Collection

Telephone interviews were conducted to collect primary data required to test the hypotheses in Exhibit 3.2. The testing of these hypotheses required that interviews be conducted with growers who have installed flow meters and growers who have not installed flow meters. Exhibit 3.7 presents the population of growers with flow meters and growers without flow meters, the planned sample for each, and the achieved sample. The number of growers with and without flow meters before the survey was assumed based on information in the program database. However, it was known that this would not be a sufficient indication of the presence or absence of flow meters. Therefore, the respondents were asked if they had flow meters at the beginning of the survey and asked the appropriate questions based on that response. Quotas were set on each cell (with and without flow meter).

Exhibit 3.7
Summary of Planned and Achieved Data Collection

Population	Assumed N in Population	Planned Sample	Achieved Sample
Growers with flow meters	126	125	125
Growers without flow meters	795	125	125
Total	921	250	250

Next, the sample disposition and response rates for these telephone interviews is presented.

Exhibit 3.8
Sample Disposition

Disposition	Counts
Completed	250
Busy	1
No Response	14
Refused	55
Disconnected	35
Answer Mach	277
Designated Respondent Not Available	68
Language Barrier	5
FAX	9
Incomplete	3
MAX Attempt	17
No Flow Meter	24
Appointments Made But Quota Reached	42
Total Calls	800

Exhibit 3.9 provides various types completion rates: 1) the pool efficiency rate, 2) the gross completion rate, and 3) the eligible completion rate. The pool efficiency rate is a measure of how efficient the sample frame was in reaching working numbers. That is, of all the numbers called,

what percent were working telephone numbers. The gross completion rate is the number of completions divided by the total number of call sheets. A more relevant number is the eligible completion rate, which is the number of completions divided by the number of households reached that were eligible. Ineligible households were ones in which English was not spoken, the respondent was hearing impaired, there was no answer, telephones were disconnected, telephone number was blocked, etc. The eligible completion rate of 38.3 percent was reasonably high.

Exhibit 3.9
Completion Rates, by Type

Various Types of Completion Rates	Completion Rates
Pool Efficiency Rate	94.5%
Gross Completion Rate	31.3%
Eligible Completion Rate	38.3%

4 Results

This section presents the results of the models used to test the hypotheses enumerated in Exhibit 3.2. As explained in Section 3, the APEP-I and APEP-II programs use both education and incentives to target a reduction in the cost at the pump for the grower by making the pump operate more efficiently. There are four areas upon which the educational portion of the program focuses: two parts of the message deal with the specifics of the pump while other two parts of the message cover water needs. Given that the amount of water used on a crop is an essential piece of knowledge for the grower, and the Program has found that only about 21% of the pumps have flow meters, the evaluation team felt that conducting primary research on flow meter usage could be beneficial.

More specifically, the pump tests provided by the program give the grower a snapshot of water flow (in gallons per minute, GPM) and energy use for the water use (kWh per acre-foot of water) at the time of the pump test; whereas a flow meter provides relevant information to the grower on water use on an *ongoing* basis. Therefore, it was posited that a flow meter would increase the persistence of the educational message regarding appropriate water use by continually reinforcing the information initially provided by a pump test. Regular observation of the pump flow rate could provide the information to catch early indications of wear on a pump that cause inefficiencies and increased energy use. Additionally, knowledge of the output of a newly repaired pump could help the growers assure that the correct water amount is used for the crop, thus assuring both water and energy savings at the pump. However, these assumptions were untested. There is much that is not known about the use of a flow meter in the pumping system and the potential behavioral changes that could occur with a flow meter and affect both energy and water use. Accordingly, the study presented in this report investigates various hypotheses relating to flow meter usage and related impacts and makes recommendations that could be useful to inform future program design in this area.

The results that follow begin with a general description of the farms and organizations that have installed a flow meter as compared to those that have not installed a flow meter. This is followed by the results of the hypotheses' tests regarding flow meter use and the associated affects on energy- and water- related behaviors and hardware decisions.

4.1 Key Characteristics: Flow Meter Installers and Non-Installers

The characteristics of the farms and organizations interviewed were investigated and compared between those who installed flow meters and those who did not install flow meters. The areas covered include: awareness of energy efficiency options relating to pumping and irrigation systems and general firmographics. The results of these comparisons are presented below.

4.1.1 Awareness of Energy Efficiency Options

Exhibit 4.1 presents information relating to the importance of making efficient use of energy and water and other ratings of the respondents' awareness of energy efficiency and efficiency options relating to pumping irrigation systems.

Exhibit 4.1
Energy Efficiency Awareness

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?*					
	Yes			No		
Question	Valid N	Mean	Standard Error of Mean	Valid N	Mean	Standard Error of Mean
<q1> How important is it for you to be sure that your pumping system makes efficient use of energy? (1=not at all important, 7=very important)	N=124	6.55	0.081	N=125	6.52	0.087
<q2> How important is it for you to be sure that your pumping system makes efficient use of water (1=not at all important, 7=very important)	N=124	6.65	0.064	N=125	6.55	0.078
<q3> How aware are you of the AMOUNT OF WATER USED by your pumps? (1=not at all aware, 7=very aware)	N=121	6.08	0.112	N=124	5.79	0.134
<q4> How aware are you of the AMOUNT OF ENERGY USED by your pumps? (1=not at all aware, 7=very aware)	N=122	5.67	0.129	N=124	5.88	0.138
<q11> How certain are you that flow meters can assist growers to reduce the operating costs of their pumps? (1=not at all certain, 7=very certain)	N=122	5.19	0.163	N=115	4.1	0.208

*Cells in dark gray indicate that the means are significantly different using a t-test.

The data presented here reveal that most respondents report a high level of awareness as it relates to pumping system efficiency and the amount of water and energy used by their pumps. Using a seven-point scale, with one meaning ‘Not at All Important’ and seven meaning ‘Very Important’, respondents indicated how important it was to them that their pumping system made efficient use of energy and water. For both installers and non-installers, and for both variables, energy and water, the mean level of importance is over 6.5, which suggests that energy efficiency is important for the respondents interviewed, regardless of whether or not they had installed a flow meter. A t-test to examine whether there is a significant difference between the reported means supports this fact in that no significant difference was found. Similarly, awareness of the amount of water and energy used by their pumps was reported using a scale of one to seven, with one meaning ‘Not At All Aware’ and seven meaning ‘Very Aware’. Again, the average level of awareness is fairly high, with the mean level of awareness of water and energy used being 6.08 and 5.67, respectively for installers, and 5.79 and 5.88, respectively for non-installers. While the level of awareness of water use reported by installers is higher than for non-installers, the reported level of awareness of energy use is lower for installers versus non-installers. A t-test was conducted to determine whether the difference between the mean levels of awareness of water and energy use between these groups was significant. Results indicate that there is no significant difference between the reported mean levels of awareness of water or energy use for these groups (installers versus non-installers).

Lastly, respondents were asked to rate how certain they were that flow meters can assist growers in reducing the operating costs of their pumps. In this case, while the mean level of certainty was relatively high for both groups, the mean level of certainty that flow meters can reduce the operating cost of the pump was 5.19 for installers and 4.1 for non-installers. A t-test of the difference in the reported means suggests that there is a significant difference between installers and non-installers in terms of the mean level of certainty that flow meters can reduce the operating cost of their pumps. In other words, those that have flow meters are more certain than non-installers that a flow meter can reduce the operating costs of their pumps.

Taken together, these results suggests that while most already believe that making efficient use of water and energy is very important, and most report a high awareness of the amount of water and energy used by their pumps, there still might be a need for additional education explaining the benefits of flow meters, in particular, that flow meters can reduce the operating costs of the pumping system. This especially may be true for those who do not have flow meters in that they are less certain that flow meters can reduce the cost of operating their pumping system. These issues are considered in more depth in the discussions that follow.

An additional point to notice here is that the standard error of the mean, as indicated in Exhibit 4.1, is very small for each of the variables relating to level of awareness. This, along with the fact that the mean levels of importance or awareness are quite high, suggests that there is not much variation in the responses for the different interviewees for these variables. All respondents report high levels of awareness and of importance that their pumping system makes an efficient use of water and energy. This lack of variation means that it was difficult to assess the correlation between any one of these variables, in particular, Q3 (How aware are you of the amount of water used by your pumps) and Q4 (How aware are you of the amount of energy used by your pumps), and any of the explanatory variables used to test the different hypotheses regarding flow meter usage (see Viswanathan, 2005).

To see this more clearly, consider Exhibit 4.2, Exhibit 4.3, Exhibit 4.4, and Exhibit 4.5, which depict the frequency distributions for each of the variables, Q1, Q2, Q3, and Q4 (including both installers and non-installers). These charts illustrate the small variation in each variable and that the distribution of responses is highly skewed toward the upper end of the range of values for each variable as explained.

Exhibit 4.2
Importance Rating of Pumping System Making an Efficient Use of Energy

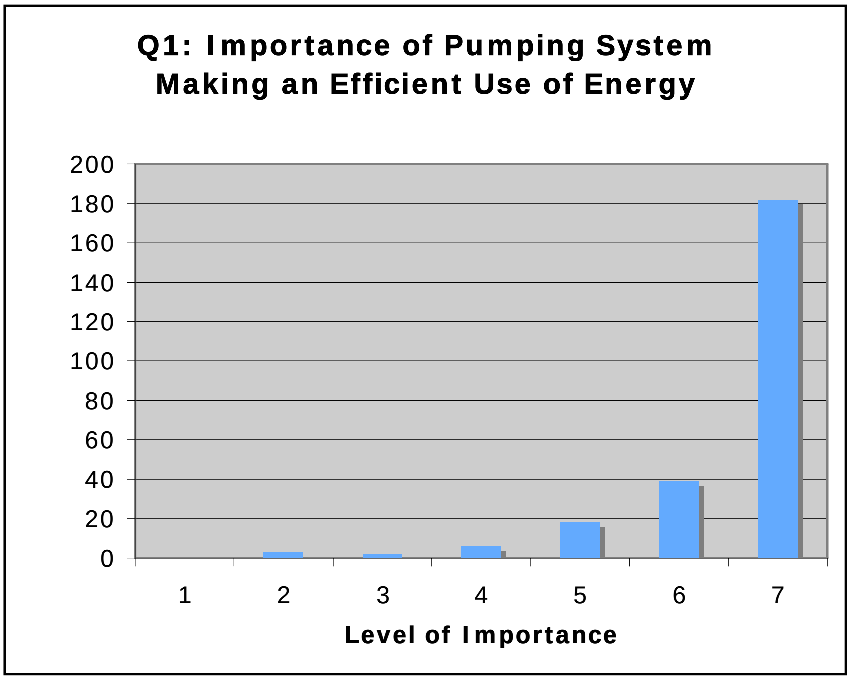


Exhibit 4.3
Importance Rating of Pumping System Making an Efficient Use of Water

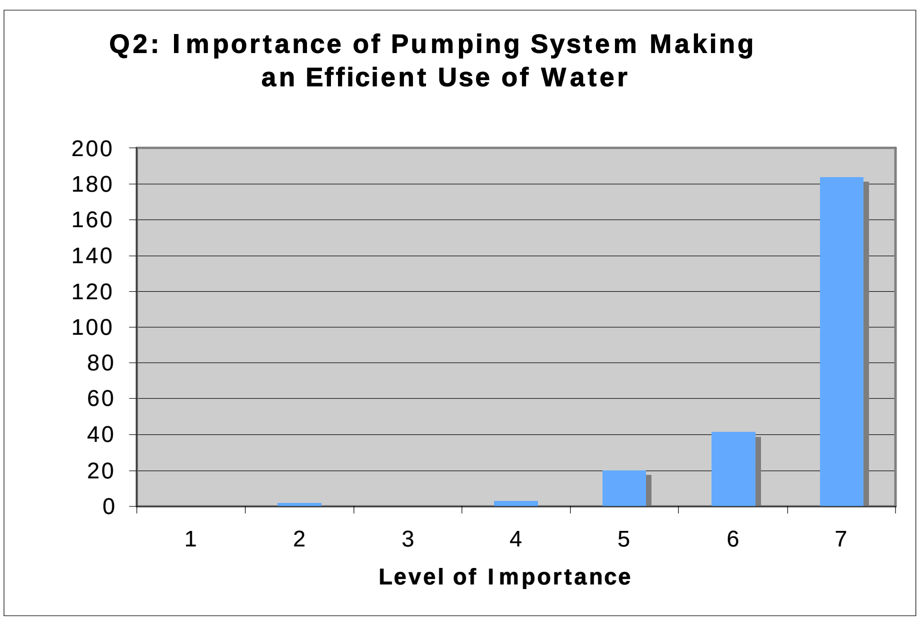


Exhibit 4.4
Awareness Rating of the Amount of Water Used by Pumps

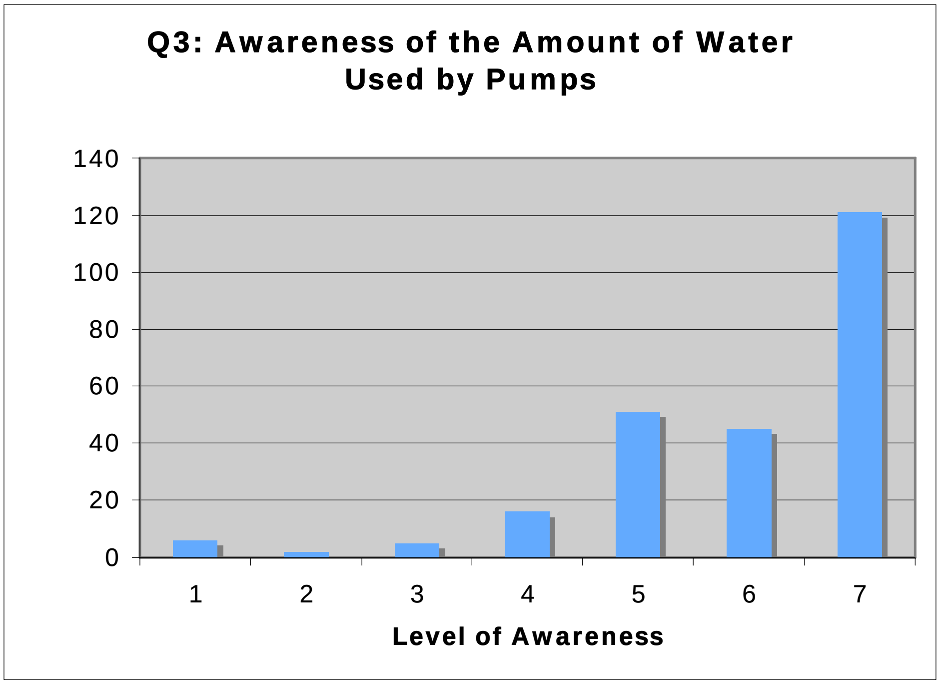
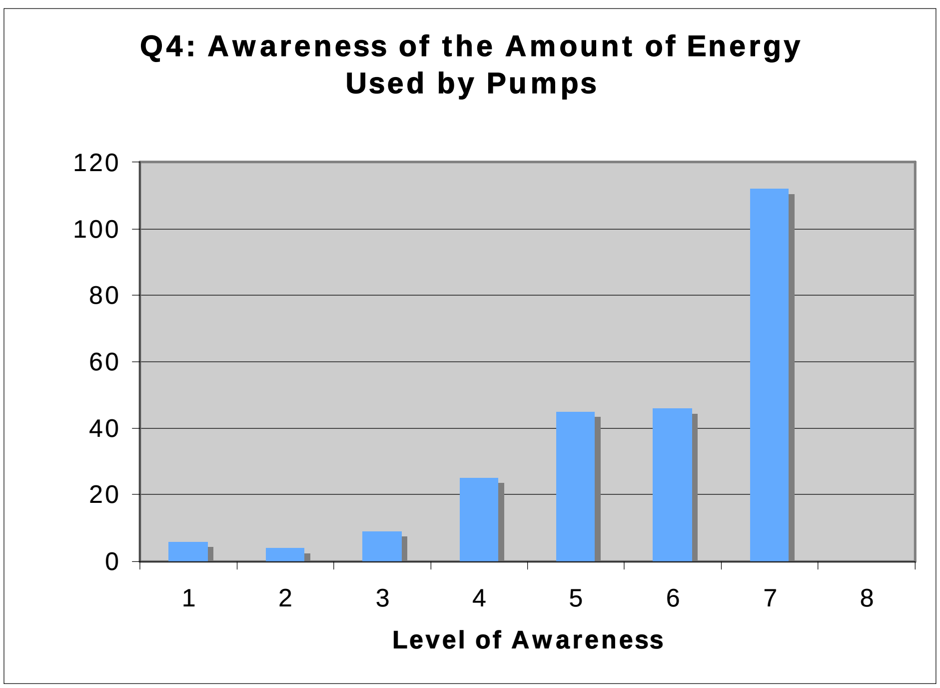


Exhibit 4.5
Awareness Rating of the Amount of Energy Used by Pumps



4.1.2 Established Practices

Respondents were also asked whether their company or organization had established energy efficiency practices as they relate to their pumping and irrigation systems. Specifically, interviewees were asked whether they recorded the energy used by their pump(s) in terms of kilowatt-hours from the utility's meter and whether their farm or organization had established practices to maintain the efficiency of their pumping systems, as well as their irrigation systems other than their pumps. As a follow-up, respondents were asked how often they recorded the energy used by their pumps and how long these practices have been in place. The findings are presented in Exhibit 4.6 and Exhibit 4.8 below.

Exhibit 4.6
Established Energy Efficiency Practices

	Did you install a flow meter on any of your pumps?*					
	YES			NO		
Do you have the indicated practice:	<q5> Do you record the energy used by your pump(s) in terms of kWh from the utility meter?	<q7> Does your organization have established practices for maintaining the efficiency of your pumping system?	<q9> Does your organization have established practices for maintaining the efficiency of irrigation system other than the pumping system?	<q5> Do you record the energy used by your pump(s) in terms of kWh from the utility meter?	<q7> Does your organization have established practices for maintaining the efficiency of your pumping system?	<q9> Does your organization have established practices for maintaining the efficiency of their irrigation system other than the pumping system?
Yes	16.3%	37.5%	43.7%	12.2%	26.2%	33.6%
No	33.9%	12.1%	6.1%	37.6%	24.2%	16.6%

*Question number percentages sum to 100% (i.e., Q5 16.3% + 33.9% + 12.2% + 37.6% = 100%) and are based on the total number of valid responses for those with *and* without flow meters installed.

The results show that relatively few, a total of 28.5% (16.3% + 12.2%) of all respondents (those with and without flow meters installed), record the energy used by their pumps in terms of kWh from the utility meter. However, a greater percentage of those who do so have flow meters, 16.3%, versus those without flow meters, 12.2%. There were relatively more respondents, a total of 63.7% and 77.3% of all respondents, respectively, who indicated that they have established practices for maintaining the efficiency of their pumping system or irrigation system other than the pumping system. Again, a greater percentage of those reporting having established efficiency practices have flow meters, 37.5%, versus those which do not have flow meters, 26.2%. Finally, a greater percentage of those reporting having established efficiency practices for maintaining the efficiency of their irrigation system other than the pumping system have flow meters (43.7%) versus those which do not have flow meters (33.6%).

Exhibit 4.7
How Often the Energy Information is Recorded

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?	
<q6> How often do you write down the total kWh information?	**Yes**	**No**
After every irrigation	2.6%	-
Once per month	59.0%	66.7%
At the beginning and end of the irrigation season	7.7%	-
Once per year	17.9%	23.3%
Some other frequency- SPECIFY	12.8%	10.0%

The results in Exhibit 4.7 show that very few, 2.6% those with flow meters, record the total kWh information after every irrigation. However, a greater percentage of those without flow meters, 66.7%, report recording the total kWh information at least once per month or less, versus 61.6% for those with flow meters. The ‘Other’ frequencies reported for writing down the total kWh information ranged from all the time to every two or three months, once per quarter, or at the end of the year or the end of the season.

Those respondents who indicated that they had established pumping and irrigation efficiency practices were also asked how long these practices have been in place.

Exhibit 4.8
Length of Time the Efficiency Practices Have Been In Place

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					
	No			Yes		
Question	**Mean**	**Standard Error of Mean**	**Valid N**	**Mean**	**Standard Error of Mean**	**Valid N**
<Q8YRS> How long have these practices been in place (unit of time in years) – pumping system practices	16.5	1.92	N=64	12.6	1.20	N=90
<Q10YRS> How long have these practices been in place (unit of time in years) – irrigation system practices other than pumps	15.9	1.56	N=83	12.5	0.81	N=105

*Cells in dark gray indicate that the means are significantly different using a t-test.

Exhibit 4.8 shows that the mean number of years that the pumping efficiency practices have been in place is 16.5 years for those without flow meters, versus 12.6 years for those with flow meters. Similarly, the mean number of years that the irrigation efficiency practices have been in place is 15.9 years for those without flow meters, and 12.5 years for those with flow meters. A t-test of the mean difference in the number of years the pumping system efficiency practices have been in place shows that there is not a significant difference between the lengths of time the practices have been in place. In contrast, a t-test of the mean difference in the number of years the irrigation system efficiency practices (other than pumps) have been in place indicates there is a significant difference between the length of time the practices have been in place for installers versus non-installers. In this case, installers have had their irrigation practices in place for a shorter time as compared to non-installers.

Lastly, respondents were asked about their perceptions of flow meter use among all farms with which they were familiar.

Exhibit 4.9
Perspectives of Flow Meter Use

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?				t value	p value
	No		Yes			
Question	Valid N	Mean	Valid N	Mean		
<q12> Of all the farming operations that you are aware of, approximately what percent have installed flow meters on at least some of their pumps?	N=95	10.08	N=97	48.19	9.815	0.000*
<q12A> Approximately what percent of these farms do you think use the information provided by flow meters at least some of the time?	N=38	47.82	N=84	69.31	3.631	0.001**

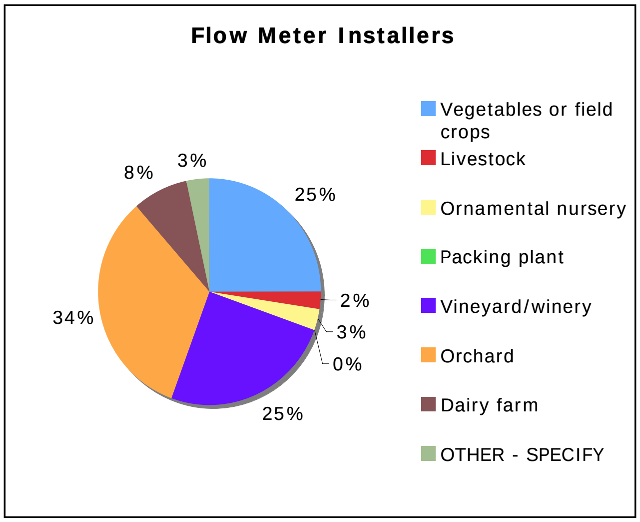
*Significant at less than the .001 level of significance.
**Significant at the .001 level of significance.

Those respondents who have flow meters report a higher percentage of known operations that have flow meters, 48%, versus 10% reported by respondents without flow meters. Similarly, respondents that have flow meters report that 69% of known farming operations with flow meters use the information provided by the flow meter, versus 48% reported by those without flow meters. A t-test of the mean difference in the reported percentage of known operations with flow meters installed on some of their pumps shows that there is a significant difference between the percentage reported by those with flow meters versus that reported by those who do not have flow meters installed. Similarly, a t-test of the mean difference in the reported percent of organizations believed to use the information some of the time shows there is a significant difference between the percentage reported by those with flow meters and that reported by those without flow meters. This suggests that, those with flow meters know a greater percentage of operations that also have flow meters installed and believe that, in general, these flow meters are used some of the time, as compared to those who do not have flow meters.

4.1.3 Firmographics

The following information provides general characteristics of the survey respondents. The results are reported for flow meter installers versus non-installers to highlight any contrasts between these types of operations.

Exhibit 4.10
Largest Source of Revenue



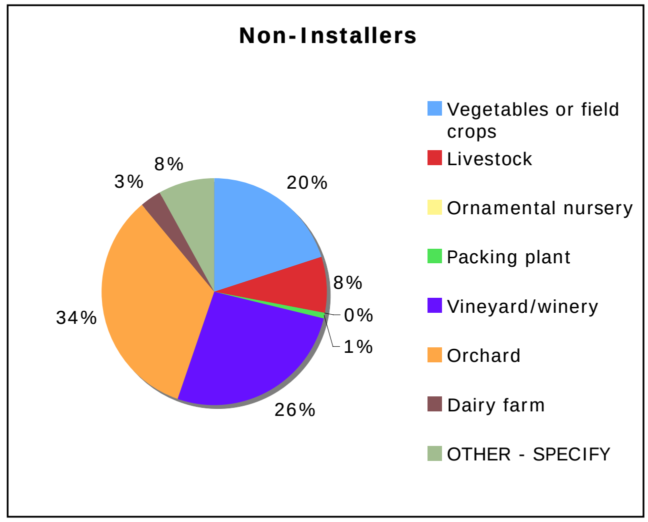


Exhibit 4.10 shows that there are similar percentages of orchards and vineyards/wineries between those with flow meters installed and those with no flow meters installed. However, for those with flow meters installed, there are a greater percentage of operations that indicate that their largest source of revenue is vegetables or field crops, dairy farms, and ornamental nurseries, respectively, as compared to those operations without flow meters installed. For those without flow meters installed, there are a greater percentage of operations that indicate their largest source of revenue is livestock, packing plants, and "other". The "Other" sources of revenue indicated by both types of respondents include: nuts (almonds and pistachios), accounting for nearly one-third of the responses, as well as citrus trees, fish farm, golf courses, poultry farm, rice and cases where the operation is divided nearly 50-50 between two different sources of revenue.

Exhibit 4.11
Land Ownership

<q37> Does your farming operation or organization own the land that you farm or where the pumps are operating?	<q13> Do you have a flow meter installed on any of the pumps in your farming operation? Yes	No
Yes, we own all of the land	66.7%	82.3%
Yes, we own a part of the land	19.5%	13.7%
No, we do not own any of the land	13.8%	4.0%
Total	100.0%	100.0%

Exhibit 4.11 shows that for both groups, most respondents report owning all of the land where their pumps are operating, with 66.7% of installers and 82.3% of non-installers. Only a very small percent report that they do not own any of the land where their pumps are operating, 13.8% for installers, and only 4% for non-installers.

Exhibit 4.12
Size of Operation or Organization

<q39> Comparing your farming operation or organization to others similar to yours, would you categorize yourself as small, medium or large?	<q13> Do you have a flow meter installed on any of the pumps in your farming operation? Yes	No
Small	28.2%	53.6%
Medium	42.7%	40.0%
Large	29.0%	6.4%
Total	100.0%	100.0%

Exhibit 4.12 shows the comparison between flow meter installers and non-installers in terms of the size of the operation or organization. Of those who had flow meters installed, the greater majority, 71.7%, classify the size of their operation or organization as 'medium' and 'large'; whereas, of those without flow meters installed, the greater majority, 93.6%, indicate that the size of their operation or organization as 'medium' and 'small'. That is, smaller farms are less likely to have installed a flow meter.

Exhibit 4.13
Length of Time at Current Location

<q40> How long has your farming operation or organization been operating at its current location?	**<q13> Do you have a flow meter installed on any of the pumps in your farming operation?** Yes	No
1 to 3 years	0.8%	6.5%
4 to 10 years	9.7%	6.5%
More than 10 years	89.5%	87.1%
Total	100.0%	100.0%

Exhibit 4.13 shows that for both installers and non-installers, over 85% of the respondents have been operating at their current location for more than 10 years. For those with flow meters, less than 1% have been in their current location between one and three years.

Exhibit 4.14
Mean Number and Age of Pumps

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					
	Yes			No		
	Mean	Standard Error of Mean	Valid N	Mean	Standard Error of Mean	Valid N
<q41> Approximately how many water pumps are used in your operation?	21.69	3.42	N=123	6.61	0.82	N=124
<q42A> Number of electric pumps?	17.85	2.85	N=123	5.68	0.68	N=124
<q42B> Number of natural gas pumps?	0.54	0.16	N=124	0.02	0.01	N=124
<q42C> Number of diesel pumps?	2.86	0.88	N=124	0.87	0.24	N=124
<q43age> What is your estimate of the average age of the pumps (in years, with midpoints given for ranges)	16.02	0.93	N=120	18.46	1.33	N=119

*Cells in dark gray indicate that the means are significantly different using a t-test.

Exhibit 4.14 shows the mean number and age of pumps comparing operations with flow meters installed and operations without flow meters installed. Operations with flow meters have an average of nearly 22 pumps in their operation in contrast to operations without flow meters installed that have approximately 7 pumps. When looking at the different types of pumps, electric, natural gas, and diesel, those with flow meters installed had more pumps than did those without flow meters installed. However, in terms of the age of the pumps, the mean age of the pumps for those with flow meters installed is less than the mean age of the pumps for those without flow meters installed. A t-test of the mean difference in the number of pumps for those with flow meters and those without flow meters installed shows there is a statistically significant difference in the number of pumps used by those who have flow meters, versus those who do not use have flow meters installed. Similarly, t-tests of the mean difference in the number of electric pumps, natural gas pumps, diesel pumps, and the age of the pumps show that each of these differences are also statistically significant. Again, these data underscore the point made earlier that larger farms are more likely to have installed flow meters.

Exhibit 4.15
Number of Months Pumps are Used Per Year

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?	
<q44> On average, how many months are the pumps used during the year?	**Yes**	**No**
Less than 3 months	5.6%	10.4%
3 to 6 months	47.6%	54.4%
7 to 9 months	32.3%	28.8%
10 Months to Year around	14.5%	6.4%
Total	100.0%	100.0%

Exhibit 4.15 shows that for both installers and non-installers, the largest percentage of respondents use their pumps between three and six months with nearly 80% of both groups using their pumps between three and nine months. Those with flow meters have a larger percentage of operations that use their pumps ten months to year-round, while those without flow meters have a larger percentage that use their pumps less than three months per year.

Exhibit 4.16
Type of Irrigation System

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?	
<q45> Which type of irrigation system do you use for the majority of the pumps at your site?	**Yes**	**No**
Drip	38.7%	23.2%
Sprinkler	24.2%	22.4%
Flood/Furrow	25.8%	48.0%
OTHER - SPECIFY	11.3%	6.4%
Total	100.0%	100.0%

Exhibit 4.16 presents the frequencies for the type of irrigation systems used and compares results for those with flow meters installed and those without flow meters installed. Those with flow meters have a greater percentage of drip and sprinkler irrigation systems as compared to those without flow meters installed. Those without flow meters have a greater percentage of flood/furrow irrigation systems than those with flow meters installed. The 'Other' type of irrigation systems indicated by respondents were: a mix of either drip/flood, 15% of all those answering "Other", drip/sprinkler, 15%, all types, 25%, or micro sprinkler, 20%.

The respondents were also queried about the magnitude of their annual energy and water costs; however, the responses included implausibly large and implausibly small values and a number of respondents indicated that they did not know. As such, the variables were not particularly useful in the models used to test the hypotheses because if they were included, too many cases would have been dropped due to missing observations or the implausibly large or small estimates would have an undue influence on the results.

4.1.4 Conclusions: Key Group Characteristics

Overall, these data show that there are important differences between the types of operations or organizations with flow meters installed and those without flow meters installed. While both installers and non-installers report that it is important to make an efficient use of water and energy, and both report a high level of awareness of the amount of water and energy used by their pumps, those with flow meters installed are more certain that flow meters can reduce the operating cost of their pumping system as compared to those who do not have flow meters installed. This might suggest a need for additional education regarding the benefits of flow meters. Further, more operations with flow meters report having established practices to maintain the efficiency of their pumping and irrigation systems; however, those without flow meters who reported that their operation or organization had established efficiency practices have had the practices in place longer than those with flow meters installed. Those with flow meters more often record the kWh information and more frequently than do those without flow meters; however, those who do not have flow meters installed report that they record the kWh information at least once per month.

Those with flow meters installed report knowing more organizations or other farmers that also use flow meters, as compared to those without flow meters installed. This might suggest that the diffusion of this technology was achieved more by word of mouth, i.e., farmers are sold on the benefits of flow meters by other farmers or organizations.

In terms of general firmographics, the largest percentages of respondents, for both installers and non-installers, report that the largest sources of revenue are orchards and vineyards/wineries. However, those operations with flow meters have larger percentages of vegetable/field crops and dairy farms, while those without flow meters have larger percentages of livestock and packing plants. The majority of both installers and non-installers report that they own at least some of the land that their pumps are operated on and have been at their current location for ten years or more. The majority of installers report being medium or large-size operations, whereas the majority of non-installers report being medium or small-size firms. The key point is that smaller operations may be less likely to install flow meters than larger ones. In terms of the number of pumps, installers have more pumps on average than do non-installers, and these pumps are newer than non-installers' pumps. For both installers and non-installers, the greater majority of pumps are electric pumps, followed by diesel and then natural gas, and the majority of both installers and non-installers indicate that they use their pumps between three and nine months per year.

Lastly, the type of irrigation system used differs between those who have flow meters installed and those who do not have flow meters installed. Installers report a greater number of drip and sprinkler type irrigation systems whereas those without flow meters report a greater number of flood/furrow type systems.

4.2 Flow Meter Installers

4.2.1 Flow Meter Usage

Respondents who installed flow meters were asked about various details relating to their flow meter usage and pumping and irrigation system management behaviors and practices. The findings are discussed below.

Exhibit 4.17
Flow Meter Usage

Question	Mean	Standard Error of Mean	Valid N
<q14> Approximately what percent of your pumps have flow meters installed?	60.44	3.34	N=122
<q14B:HOWMANY> What percentage of your flow meters are currently NOT functioning?	40.29	10.97	N=7
<q19> How often do you use information from a flow meter? (1=Never and 7=Consistently)	5.41	0.15	N=124
<q27> How confident are you that the information provided by flow meters is accurate? (1=Not at all confident and 7=Very confident)	5.51	0.13	N=123
<q28> How confident are you in your ability to interpret changes in the readings from a flow meter? (1=Not at all confident and 7=Very confident)	5.58	0.14	N=121

Exhibit 4.17 shows the average values for different flow meter usage statistics. These data show that the average percentage of pumps with flow meters is 60%. Respondents were also asked how many of these flow meters were functioning, and 94.3 % indicated that all of their flow meters were functioning, while 5.7% indicated that all of their flow meters were *not* functioning. Thus, for all growers with flow meters installed on at least some of their pumps, 58.7% of their pumps have *working* flow meters.

Respondents were also asked to rate how consistently they used the information from the flow meter. The average rating was 5.41 on a scale from one to seven, with one meaning “Never” and seven meaning “Consistently”. In addition, using a seven point scale, with one meaning “Not at All Confident”, and seven meaning “Very Confident”, respondents were asked to rate their confidence that the information provided by the flow meter is accurate and their confidence in their ability to interpret changes in the readings from a flow meter. The mean level of confidence in the accuracy of the flow meter information was 5.51 and the mean level of confidence in their ability to interpret changes in the flow meter readings was 5.58. While this suggests an above average consistency of use and above average level of confidence in the information and in their ability to interpret the flow meter data, the ratings are not as high as the reported levels of awareness as presented in Section 4.1.1

Exhibit 4.18
Length of Time the Flow Meters Have Been Installed

<q15> Approximately how long ago were most of the flow meters installed?	%
Within the last year	4.1%
Within the last 2 to 3 years	21.1%
Within the last 4 to 5 years	24.4%
More than five years ago	50.4%
Total	100.0%

Exhibit 4.18 shows data on how long ago the flow meters were installed. The majority of respondents indicated that their flow meters were installed more than five years ago, with nearly 75% indicating that their flow meters are at least four years old or older. Exhibit 4.19, below, shows data on who was responsible for installing the flow meters. More than 80% of those interviewed report that they were responsible for the decision to install the flow meters, with only about 18% indicating that someone else, other than themselves or their company, was responsible for the decision to install the flow meters.

Exhibit 4.19
Responsibility for Installing Flow Meters

<q16> Were you or your company responsible for making the decision to install these flow meters?	%
Yes, I was responsible	82.1%
No, neither was responsible	11.4%
NO, meters installed when I purchased business or before I was hired by the company	6.5%
Total	100.0%

4.2.2 Flow Meter Benefits

When asked about their perceived benefits of flow meters, respondents who have flow meters provided wide-ranging responses. Exhibit 4.20 presents a summary of the statements given by flow meter installers.

Exhibit 4.20
Benefits of Flow Meters

Reported Benefit	Count	Percent of Responses
Accurate Evaluation of Water Use	5	3.6%
Allows Efficient Use of Water/Control Water Flow	9	6.6%
Track Water Use/Make Sure Enough Water is Flowing	47	34.3%
Decrease Cost of Pumping	14	10.2%
Gives Flow Rate	17	12.4%
Detect Problems with Pumps/Track Efficiency of Pump	33	24.1%
Track Cost of Water Using	4	2.9%
Track Water Use to Apply Correct Amount of Chemicals	2	1.5%
Track Use to Divide Bill Between Farms	2	1.5%
Required By District/Use to Report Water Usage	3	2.2%
No Benefit	1	0.7%
Total	137	100%

The most common benefit cited, 34.3% of responses, was that flow meters can be used to track water use or make sure that enough water is flowing. The next most common response, 24.1% of responses, is that flow meters are used to detect problems with the pumps or to track efficiency of the pump. A limited number of respondents indicated that the flow meter could be used to decrease the cost of pumping or increase the efficiency of the pumping/irrigation system. As mentioned, most indicated that the flow meter was used to track water usage, however, they did not specifically tie this to improving efficiency or decreasing costs. Only one respondent commented that there were no benefits.

As a follow-up, respondents were asked how they learned about the benefits of flow meters. Exhibit 4.21 presents these results.

Exhibit 4.21
Primary Source of Information About the Benefits of Flow Meters?

<q18> How did you learn about the benefits of flow meters?	Count	Column %
APEP Program	4	3.3%
It is a long-time farming practice	26	21.3%
Utility Representative	2	1.6%
Word of Mouth	9	7.4%
Pump Test Company	8	6.6%
Trade Publication	7	5.7%
Through an agricultural organization	12	9.8%
Other	66	54.1%
Refused		
Don’t Know	3	2.5%
Total	122	100.0%

The “Other” category accounted for 54.1% of the responses and included sources such as: irrigation/pump company or supplier, accounting for nearly 23% of the “Other” responses, seminars/courses (general and PG&E), 21%, common knowledge/experience, 19%, and City/County/Irrigation district mandate, 13%. Some also reported learning through trade shows, contractors and consultants their irrigation district, growers, and CIT seminars (3.2% of the “Other” responses). The prevailing response aside from “Other” was that using flow meters is a long-time farming practice, accounting for 21.3% of the total responses. The next largest response category was ‘Through an Agricultural organization’ at 9.8% of the responses. The APEP Program accounted for 3.3% of responses (in addition to those mentioned in the “Other” response category).

4.2.3 Use of Flow Meter Information

Respondents with flow meters were asked about their use of the flow meter information, including whether they recorded the flow rate on a regular basis, whether they recorded the total volume reading and, if they recorded the total volume reading, whether they used the total volume reading in conjunction with the kWh information from the utility meter to calculate the kWh per acre-foot of water used. Exhibit 4.22, Exhibit 4.23, and Exhibit 4.24 show these results.

Exhibit 4.22
Percent Who Record the Flow Rate Regularly

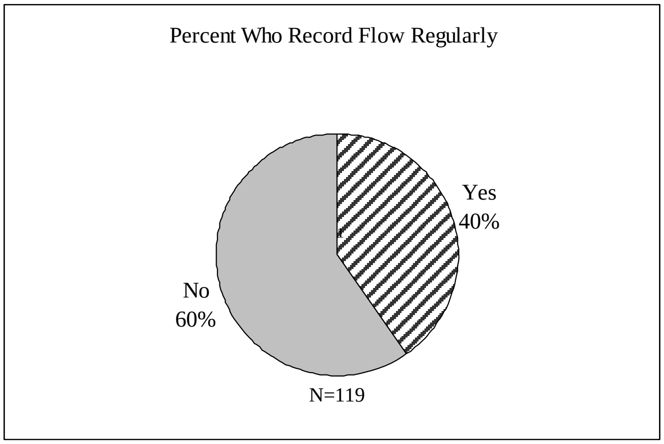


Exhibit 4.23
Percent Who Record the Total Volume Reading

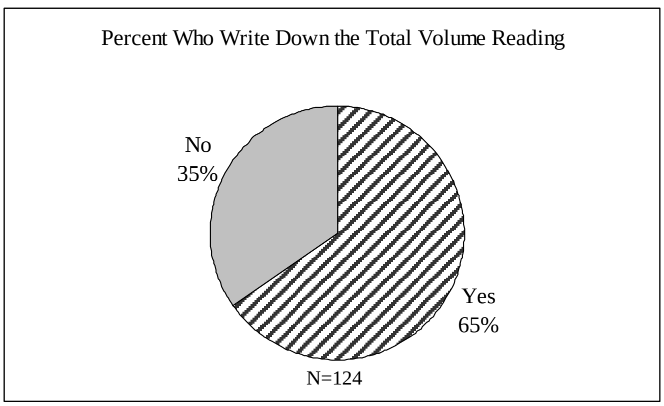
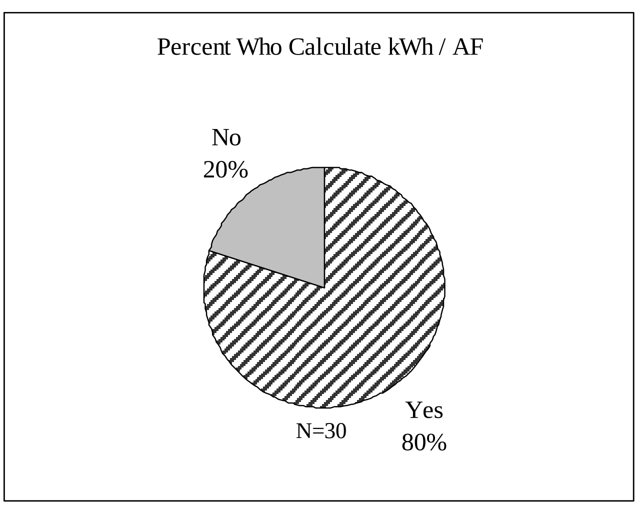


Exhibit 4.24
Percent Who Calculate kWh Per Acre-Ft of Water Used



These show that, 40% all respondents with flow meters record the flow rate regularly, while 65% of all respondents with flow meters record the total volume reading. Previously, all respondents (including those with and without flow meters installed) were asked whether they recorded the kWh information from the utility meter (See Exhibit 4.6). The percentages reported in Exhibit 4.6 are based on the total number of respondents with valid responses for these questions. Exhibit 4.25 below shows the percent of respondents *with flow meters*, who indicate that they record the kWh information from the utility meter. There are 32.5% of respondents *who have flow meters installed*, record the kWh information from the utility meter. Exhibit 4.25 also summarizes the information presented in Exhibit 4.22, Exhibit 4.23, and Exhibit 4.24 above. Note that, 77.5% of those who indicate that they record the kWh information from the utility meter also record the total volume reading. Of this 77.5% who report recording *both* the kWh information and the total volume reading, 80% indicate that they use this information to calculate the kWh per acre-foot of water used.

Exhibit 4.25
Summary Statistics on Use of Flow Meter Information: Flow Meter Installers

Action Performed	Base N	Percent who Performed Indicated Action	N who Performed Indicated Action
Record kWh from utility meter <Q5>	123	32.5%	40
Record flow rate (FR) < Q21>	119	40.3%	48
Record total volume reading (TVR) <Q24>	124	65.3%	81
Of those who record kWh, also record the TVR	40	77.5%	31
Use kWh information and TVR to calculate the kWh per acre-foot of water used <Q26>	30	80%	24

*The total number of interviewees with flow meters is 125. The Base N is the number of interviewees with flow meters installed who had valid responses for this indicated question(s).

Exhibit 4.26
Frequency of Use of Flow Meter Information

Reported Frequency	<Q20> How often do you look at the current reading on your flow meter(s) during the irrigation season?	<Q22> How often do you record the flow rate?	<Q25> How often do you write down the total volume information?
Never	4.0%	-	-
After every irrigation	23.4%	18.8%	13.6%
Once per month	22.6%	37.5%	42.0%
At the beginning and end of the irrigation season	3.2%	2.1%	12.3%
Once per year	3.2%	4.2%	17.3%
Some other frequency -SPECIFY	43.5%	37.5%	14.8%
Total	100.0%	100.0%	100.0%

These data show that the largest percentage of respondents (43.5%) look at the current flow meter readings at some other frequency than listed here. In particular, respondents primarily indicated that they look at the readings daily, at the beginning of each irrigation, or once per week. The next most common frequencies are 'After Every Irrigation', 23.4% and 'Once Per Month', 22.6%. Of those who regularly record the flow rate information (See Exhibit 4.25), 37.5% state that they record the information once per month, and 18.8 % record the data after every irrigation. Another 37.5% of the respondents who record the flow rate information, report recording this information some other frequency, that primarily being, daily or one time per week. Finally, of those respondents who write down the total volume reading (See Exhibit 4.25), 42% record the information at least once per month, 17.3% once per year, and 13.6% after every irrigation. Other frequencies reported include: weekly, daily, twice per month, after each cropping, or quarterly.

To further assess behaviors and use of the flow meter information, respondents were asked what they did with the flow meter information when there is a change in the flow rate. Exhibit 4.27 presents these results.

Exhibit 4.27
Use of Flow Meter Information When the Flow Rate Changes

<q23> What do you do with the flow meter information when there is a change in the flow rate?	Count	Column %
Contact your pump dealer	12	9.7%
Contact your electric utility rep	1	0.8%
Contact a pump tester	10	8.1%
Record the reading for future reference	3	2.4%
Nothing, just remember when it changed	10	8.1%
Other	89	71.8%
Refused		
Don’t Know	4	3.2%
Total	124	100.0%

The majority of respondents, 71.8%, report that they take some other action than those listed here. In almost all cases, the respondents indicated that they troubleshoot the problem and then fix it if possible. In a few cases, respondents contact their irrigation specialist or company or have the pump tested. Some monitor the problem until the off-season to make a determination how to deal with the problem or whether a repair needs to be made, or they flush the line and re-test. A few respondents indicated that they increase the water pressure if the flow rate decreases and a couple indicated that they switch to an alternative water/pump source. The next most common response, 9.7% of responses, is that they contact their pump dealer. In addition, 8.10% report that they contact a pump tester, and another 8.1% indicate that they do nothing other than just remember when it changed.

4.2.4 Conclusions: Flow Meter Installers

For most respondents, their flow meters are more than five years old. The majority of those surveyed were responsible for the decision to install the flow meters. Not all pumps have flow meters installed. However, nearly 94% of operations and organizations with at least one flow meter, have a reasonably large average percentage of pumps with working flow meters installed (60%), for nearly 6% of respondents, the average percentage of pumps with working flow meters is only about 36%. Also, users give moderate ratings of their consistency in using the flow meter information, as well as their confidence in the accuracy of information provided by the flow meter, and their ability to interpret changes in the flow meter readings.

With regard to stated benefits of using flow meters, respondents indicated the main benefits are that flow meters can be used to track water use and ensure that they are using the right amount of water. Some also indicated that flow meters help to maintain the efficiency of their pumps and to reduce the cost of operating their pumps. Respondents indicate that they learned about the benefits of flow meters through a variety of means including courses and seminars, irrigation companies, or by city/county mandate, while others indicate that using flow meters is a longtime family practice. Others reported learning about flow meters through the APEP Program, and in particular, through CIT seminars and demonstrations.

In general, a good percentage of the respondents report reading the flow meter and recording this information at least once per month. A small percentage of respondents record the flow rate information, while more record the total volume information. Of the small percentage, who record the total volume information and also record the kWh information from the utility meter, 80% of these calculate the kWh per acre-foot of water used.

While some respondents report using their flow meters to some extent, whether in terms of recording the total volume information or to track their water usage, there are still significant percentages of users who do not make full use of their flow meters. While 6% of respondents indicate that at least 40% of their flow meters are not functioning, nearly 60% report that they do not record the flow rate on a regular basis. When asked about the benefits of flow meters, most reported that they are good for tracking water use, as opposed to indicating that flow meters are beneficial for increasing the efficiency of their pumping system or to inform irrigation management decisions or decisions to change their pumping system hardware.

These results seem to point to a need for continued education about the benefits of using flow meters, to ensure that users understand how to use the flow meter information and that the flow meter can be used to decrease the cost of operating their pumping system.

4.3 Study Hypotheses

The following sections discuss the results of the models used to test the 14 hypotheses posited regarding flow meter use and pumping and irrigation system behaviors. For each hypothesis, the type of analysis used is explained and it is noted whether there was weak, moderate, strong, or no support. In addition, for each of the hypotheses considered A discussion is provided on the potential implications of the findings as they relate to future program design considerations regarding flow meters.

4.3.1 Interpretation of Tables

There are two types of tables presented in this section. One set of tables presents the results of logistic regression models while the other presents the results of ordinary least squares regression models.

The results for both types include the number of observations in the model (N) and the statistical significance of the independent variable which is the focus of a particular hypothesis. This significance is reflected in the value of the probability, ***p***, in each of the tables. When the independent variable of interest is significant at a $p \le 0.01$ level, this suggests *strong* support for the hypothesis. When the independent variable of interest is significant at a $p > 0.01$ and ≤ 0.05, this suggests *moderate* support for the hypothesis. Finally, when the independent variable of interest is significant at a $p > 0.05$ and ≤ 0.10, this suggests *weak* support for the hypothesis. When the independent variable of interest is significant at a $p > 0.10$ level, this suggests *no* support for the hypothesis.

For the logistic model, the odds-ratio is presented. If the value is greater than one, the odds are increasing; if the value is less than one, the odds are decreasing. A value of 1 leaves the odds unchanged. Consider the following example for which in a given logistic model the odds ratio for the variable, “Large Farm,” was 1.62. Then odds ratio indicates that as the size of the firm goes from ‘Small Farm’ or ‘Medium Farm’ to ‘Large Farm’ the likelihood the customer will install a flow meter, for example, increases by 1.62.

For OLS regression models, the R-square value is provided (which shows the proportion of variance explained by the model) and the R-square change value (which shows the increment in the explained variance that is accounted for when the independent variable is entered into the model). In this analysis, an R-square value of 25% (0.25) was considered to be acceptable. A value of about 3% for the R-square change is considered to be of practical interest to program planners. That is, from a programmatic perspective, a variable that explains 3% of the variance in a given dependent variable is probably worth the program planner's attention.

4.3.2 Hypothesis 1

This hypothesis stated that growers who install flow meters are more aware of the water and energy used by their pumps. Note that two hypotheses were actually tested, one for awareness of water use and one for awareness of energy use. For the first hypothesis, two logistic models were estimated. The results of this hypothesis test are presented in Exhibit 4.28.

Exhibit 4.28
Hypothesis 1 OLS Model Results

Independent Variable: Percent of working flow meters <pwrkgfm4>				
Dependent Variable	**N**	***p****	**Adjusted R-square**	**R-Square Change**
Awareness of Water Use	216	0.0314	0.029	0.016
Awareness of Energy Use	217	0.9800	0.0833	0.005

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

One of the models tested found a significant relationship (p=0.03) between the Percent of Pumps with Working Flow Meters (PWRKGFM4) and the Awareness of Water at Use. If the direction of this relationship is correct, then flow meters can increase one's awareness of water use. This constitutes moderate support. However, the Percent of Working Flow Meters does not appear to affect Awareness of Energy Use (p=.98). That the effect of flow meters on awareness is different for water than for energy suggests that the Program should continue to emphasize both water and energy use reductions.

While the fact that one of the models exhibited moderate support while the other exhibited no support constitutes only weak overall support for this hypothesis. However, the fact that it appears those who have installed flow meters are more aware of water use than those who did not install flow meters is important.

4.3.3 Hypothesis 2

This hypothesis stated that increased awareness of water flow rates and energy use causes growers to change their irrigation and other pumping system related behavior. Two separate hypotheses were investigated. One hypothesis is that increased awareness of water flow rates causes growers to change their irrigation and other pumping system related behavior. A second hypothesis is that increased awareness of energy causes growers to change their irrigation and other pumping system related behavior.

To test each of these hypotheses, eight separate models were estimated. In each model, the seven questions regarding behavioral changes that could improve the efficiency of the pumping or irrigation system were used as the dependent variable in a model. Each of these dependent variables was regressed on a number of independent variables, which included the key independent variable (e.g., awareness of water use or awareness of energy use) and a number of covariates (control variables) such as size of the farm, and type of irrigation. An eighth OLS regression model was estimated that used as the dependent variable the sum of those behavioral changes implemented (0 to 7) along with the same independent variables. The results of this hypothesis test are presented in Exhibit 4.29 through Exhibit 4.32.

Exhibit 4.29
Hypothesis 2 Logistic Model Results: Awareness of Water Used by Pumps

Independent Variable: How aware are you of the AMOUNT OF WATER used by your pumps? <Q3>			
Dependent Variable	**N**	***p****	**Odds Ratio**
Q30AA. Determine how much water to apply for an irrigation using soil, plant, or weather based measurements [water savings]	217	0.745	1.042
Q30BA. Measure the soil moisture in a field after irrigations to determine how effective they were. [energy/water savings]	216	0.493	1.080
Q30CA. For drip or micro-sprinkler systems: inspect, clean and replace defective emitters or sprinklers at least once per year. [water savings]	158	0.932	0.977
Q30DA. For impact sprinkler systems: replace worn nozzles at least once per year and use a mid-field mainline placement during the season. [water savings]	101	0.711	1.066
Q30EA. For drip and sprinkler systems: regularly monitor and adjust system pressures, clean in-line screens, and flush lines at least once a year. [water/energy savings]	166	0.614	0.833
Q30FA. For surface irrigation systems: shorten run lengths and/or convert from open ditches to gated pipe. [energy/water savings]	140	0.044	1.400
Q30GA. Do you grow crops that use less water, in other words, have you changed the crops you grow so that you use less water [energy/water savings]	219	0.382	1.177

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Only one of the models has a *p* value that indicates moderate support. As awareness about the amount of water used by one's pumps increases, the odds that one will shorten run lengths and/or convert from open ditches to gated pipe increase by 1.40.

Exhibit 4.30
Hypothesis 2 OLS Model Results: Awareness of Water Used by Pumps

Independent Variable: How aware are you of the AMOUNT OF WATER used by your pumps? <Q3>				
Dependent Variable	**N**	***p****	**Adjusted R-square**	**R-Square Change**
ttlbehv: total number of (sum of all) behavioral changes that were implemented	219	0.399	0.315	0.001

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

The result in Exhibit 4.30 shows no support for the hypothesis that increased awareness in the amount of water used by pumps increases the number behavioral changes that are implemented.

Exhibit 4.31
Hypothesis 2 Logistic Model Results: Awareness of Energy Used by Pumps

Independent Variable: How aware are you of the AMOUNT OF ENERGY used by your pumps? <Q4>			
Dependent Variable	**N**	***p****	**Odds Ratio**
Q30AA. Determine how much water to apply for an irrigation using soil, plant, or weather based measurements [water savings]	218	0.935	0.99
Q30BA. Measure the soil moisture in a field after irrigations to determine how effective they were. [energy/water savings]	217	0.366	1.209
Q30CA. For drip or micro-sprinkler systems: inspect, clean and replace defective emitters or sprinklers at least once per year. [water savings]	158	0.148	0.600
Q30DA. For impact sprinkler systems: replace worn nozzles at least once per year and use a mid-field mainline placement during the season. [water savings]	101	0.363	0.861
Q30EA. For drip and sprinkler systems: regularly monitor and adjust system pressures, clean in-line screens, and flush lines at least once a year. [water/energy savings]	166	0.529	1.179
Q30FA. For surface irrigation systems: shorten run lengths and/or convert from open ditches to gated pipe. [energy/water savings]	141	0.592	1.089
Q30GA. Do you grow crops that use less water, in other words, have you changed the crops you grow so that you use less water [energy/water savings]	220	0.981	1.004

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

The result in Exhibit 4.31 shows that none of the p values are less than 0.10. This indicates that there is no support for this hypothesis.

Exhibit 4.32
Hypothesis 2 OLS Model Results: Awareness of Energy Used by Pumps

Independent Variable: How aware are you of the AMOUNT OF ENERGY used by your pumps? <Q4>				
Dependent Variable	**N**	***p****	**Adjusted R-square**	**R-Square Change**
ttlbehv: total number of (sum of all) behavioral changes that were implemented	220	0.953	0.311	0.003

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

From Exhibit 4.32, one can see again that there is no support for this hypothesis.

In summary, except for one model, all the models indicate that there is no support for either of the two hypotheses. This is thought to be due primarily to the fact that there is so little variance in the levels of awareness (see Exhibit 4.4 and Exhibit 4.5). This fact and the problems that it creates were fully described in Section 4.1.1.

4.3.4 Hypothesis 3

This hypothesis stated that cost is a major barrier to the installation of flow meters. This hypothesis was tested using only the results of the non-installer survey. Exhibit 4.33 shows that cost is indeed one of the most important obstacles to installing a flow meter. However, an examination of the ‘Other’ category reveals another significant obstacle, which is that, for a variety of reasons, the respondents simply do not believe that they need a flow meter. For 46 of the 79 respondents who indicated ‘Other’, they suggested that they did not need a flow meter because: they did not perceive any benefits to having a flow meter, no one uses flow meters, they could measure/monitor the flow rate in other ways, they got yearly pump tests and therefore know how well their pumps were performing, they have enough water, or their type of pumping/irrigation system did not require that they use a flow meter. Nevertheless, there is strong support for the hypothesis that cost is a major barrier to the installation of flow meters.

Exhibit 4.33
Hypothesis 3 Results: Cost is a Major Barrier to Installation of Flow Meters

Barriers	Count	% Response	% Cases
Cost	25	16.6	20.2
Lack of awareness	8	5.3	6.5
Lack of information about flow meters	8	5.3	6.5
Don’t believe flow meters are beneficial	15	9.9	12.1
Distrust of how the information could be used by the Government	4	2.6	3.2
Don’t think they are accurate	0	0	0
Require too much time to read regularly and record	0	0	0
They are too difficult to interpret	0	0	0
My piping configuration does not work well with flow meters	1	0.7	0.8
Other	79	52.3	63.7
Don't Know	11	7.3	8.9
Total Responses	151	100.0	121.8

4.3.5 Hypothesis 4

This hypothesis stated that growers who install flow meters are more likely to make behavioral changes that improve the efficiency of their pumping or irrigation system. The results of the initial examination of this hypothesis are presented in Exhibit 4.34. This table presents data that compares the percentage of respondents that implemented the indicated behavioral changes listed in column one, for those that have flow meters installed and those that do not have flow meters installed. The percentages in column two are for those with flow meters; the percentages in column three are for those without flow meters. The value in column four is the mean rating reported by flow meter installers as to the level of influence having a flow meter had on the decision to implement the indicated behavioral change. The influence rating is based on a scale of one to seven, with one meaning ‘Not at All Influential’ and seven meaning ‘Very Influential’. The last three columns present the results of the bivariate analysis that tests whether the observed relationships between the respective dependent variables (Q30AA – Q30GA) and the independent variable, whether or not a respondent installed a flow meter, is significant. Column five shows the value of the Chi-Square statistic, column six shows the significance of the Chi-Square statistic, and the final column shows the strength of the relationship indicated in the bivariate analysis by the Somers’ d statistic. The cases for which the value of the Chi-Square statistic is significant are marked with an asterisk. Somer’s D is a statistic that measures the strength of the relationship between two variables. It ranges from -1, indicating perfect negative relationship to +1, indicating a perfect positive relationship.

Exhibit 4.34
Chi-Square Analyses: Behavioral Changes

	Did you Install a Flow Meter?					
	Yes	No				
Dependent Variable	**Percent of Installers Who Took Indicated Action**	**Percent of Non-Installers Who Took Indicated Action**	**Influence of Flow Meter (Installers)**	**Chi-Square**	***p***	**Strength of Relationship (Somer's D)**
Q30AA. Determine how much water to apply for an irrigation using soil, plant, or weather based measurements [water savings]	40.2	28.9	2.87	14.928	0.000**	0.228
Q30BA. Measure the soil moisture in a field after irrigations to determine how effective they were. [energy/water savings]	30.6	19.2	2.96	13.26	0.000**	0.233
Q30CA. For drip or micro-sprinkler systems: inspect, clean and replace defective emitters or sprinklers at least once per year. [water savings]	55.4	37.9	2.85	3.111	0.078	0.067
Q30DA. For impact sprinkler systems: replace worn nozzles at least once per year and use a mid-field mainline placement during the season. [water savings]	31.2	15.6	3.06	1.970	0.160	0.137
Q30EA. For drip and sprinkler systems: regularly monitor and adjust system pressures, clean in-line screens, and flush lines at least once a year. [water/energy savings]	54.9	38.0	3.89	3.948	0.047*	0.076
Q30FA. For surface irrigation systems: shorten run lengths and/or convert from open ditches to gated pipe. [energy/water savings]	21.7	26.7	2.71	0.178	0.673	-0.033
Q30GA. Do you grow crops that use less water, in other words, have you changed the crops you grow so that you use less water [energy/water savings]	5.7	6.9	2.23	0.305	0.581	-0.023

*Significant at less than the 0.05 level.
**Significant at less than the 0.001 level

Of the seven relationships examined, the Chi-square statistic is significant for three of them. Having a statistically significant chi-square only indicates that the observed relationship was beyond chance. However, it says nothing about the *strength* of the relationship, which is measured by the Somer's D statistic. It is possible that while the Chi-square is statistically significant, the strength of the relationship is so small that it is of no practical significance to program managers. With this in mind, the Somer's D ranges range from a negative 0.033 to a positive 0.233. These results suggest that flow meters are not very influential in the decisions to make these behavioral changes. The self-reported influence of the flow meter in making these behavioral changes also support this conclusion with an average of 2.90 (on the 7-point scale) across all seven behaviors.

While the relationships of individual variables to whether pumping system and irrigation behavioral changes were examined in previous sections, it is always useful to examine the relationships of all these variables simultaneously in a multivariate logistic regression analysis where the effects of the other variables can be statistically controlled. In such an environment, previously undetected relationships might emerge while other previously observed relationships might disappear. Therefore, logistic and OLS regression models were formulated to explain why customers decide to make behavioral changes that improve the efficiency of their pumping or irrigation system.

To test each of these this hypotheses, eight separate models were estimated. In each model, the seven questions regarding behavioral changes that could improve the efficiency of the pumping or irrigation system were used as the dependent variable in a model. Each of these dependent variables was regressed on a number of independent variables, which included the key independent variable (e.g., Percent of Pumps with Working Flow Meters) and a number of covariates (control variables) such as size of the farm, and type of irrigation. An eighth OLS regression model was estimated that used as the dependent variable the sum of those behavioral changes implemented (0 to 7) along with the same independent variables. Exhibit 4.34 summarizes the results.

As shown in Exhibit 4.34, the multivariate models confirms at least two (one was moderate and one was weak) of the four cases in which there were statistically significant ($p < 0.10$) Chi-squares. As the percent of pumps with working flow meters increases, the odds of:

1. determining how much water to apply for an irrigation using soil, plant, or weather based measurements increases by 1.009, and
2. regularly monitoring and adjusting system pressures, cleaning in-line screens, and flushing lines at least once a year increases by 1.034.

However, in general the odds ratios across all models confirm what was seen from the Somer's D statistic and the self-report influence of the flow meter which is that these relationships are not particularly strong.

Exhibit 4.35
Hypothesis 4 Logistic Model Results

Independent Variable: Percent of Pumps with Working Flow Meters Installed <pwrkgfm4>			
Dependent Variable	**N**	***p****	**Odds Ratio**
Q30AA. Determine how much water to apply for an irrigation using soil, plant, or weather based measurements [water savings]	216	0.039	1.009
Q30BA. Measure the soil moisture in a field after irrigations to determine how effective they were. [energy/water savings]	215	0.363	1.003
Q30CA. For drip or micro-sprinkler systems: inspect, clean and replace defective emitters or sprinklers at least once per year. [water savings]	156	0.273	1.011
Q30DA. For impact sprinkler systems: replace worn nozzles at least once per year and use a mid-field mainline placement during the season. [water savings]	98	0.513	1.004
Q30EA. For drip and sprinkler systems: regularly monitor and adjust system pressures, clean in-line screens, and flush lines at least once a year. [water/energy savings]	164	0.057	1.034
Q30FA. For surface irrigation systems: shorten run lengths and/or convert from open ditches to gated pipe. [energy/water savings]	139	0.554	0.997
Q30GA. Do you grow crops that use less water, in other words, have you changed the crops you grow so that you use less water [energy/water savings]	218	0.322	1.006

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.36
Hypothesis 4 OLS Model Results

Independent Variable: Percent of Pumps with Working Flow Meters Installed <pwrkgfm4>				
Dependent Variable	**N**	***p****	**Adjusted R-square**	**R-Square Change**
ttlbehv: total number of (sum of all) behavioral changes that were implemented	218	0.081	0.329	0.018

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Taking all these results into account, the support for this hypothesis is weak at best.

4.3.6 Hypothesis 5

The hypothesis tested was that growers who believe that a flow meter can reduce operating costs are more likely to install a flow meter. The results of this hypothesis test are presented in Exhibit 4.37.

Exhibit 4.37
Hypothesis 5 Model Results

Independent Variable: How certain are you that flow meters can assist growers to reduce the operating costs of their pumps? <Q11>			
Dependent Variable	**N**	**Significance**	**Odds Ratio**
Q13: Installation of at least one flow meter – Yes/No	220	0.0004	1.443

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Clearly, the results presented here, along with the results from the bivariate analysis presented in Section 4.1.1, indicate that there is strong support for this hypothesis. This suggests that the program should emphasize that flow meters can, if used properly, reduce the operating costs of pumps.

4.3.7 Hypothesis 6 and 13

The hypotheses tested were that growers who are confident in the accurate reading of the flow meter *and* who are confident in their ability to interpret changes in the reading of a flow meter are more likely to change their irrigation management or other pumping system related behavior. These hypotheses only involve those with flow meters. The results of these hypothesis tests are presented in Exhibit 4.38 and Exhibit 4.39.

To test each of these this hypotheses, again eight separate models were estimated. In each model, the seven questions regarding behavioral changes that could improve the efficiency of the pumping or irrigation system were used as the dependent variable in a model. Each of these dependent variables was regressed on a number of independent variables, which included the key independent variable (e.g., Confidence in the Accurate Reading of the Flow Meter *and* Confidence in their Ability to Interpret Changes in the Reading of a Flow Meter) and a number of covariates (control variables) such as size of the farm, and type of irrigation. An eighth OLS regression model was estimated that used as the dependent variable the sum of those behavioral changes implemented (0 to 7) along with the same independent variables.

Only one of the models produced statistically significant results. One’s confidence that the information provided by flow meters is accurate has a moderate impact on whether one replaces worn nozzles at least once per year and uses a mid-field mainline placement during the season. As one’s confidence increases, the odds of engaging in this behavior increase by 2.32. Based on these results, there is no support for this hypothesis.

Exhibit 4.38
Hypotheses 6 & 13: Logistic Model Results

Independent Variables: How confident are you that the information provided by flow meters is accurate? <Q27> AND How confident are you in your ability to interpret changes in the readings from a flow meter? <Q28>

		Q27		Q28	
Dependent Variable	**N**	***p****	**Odds Ratio**	***p****	**Odds Ratio**
Q30AA. Determine how much water to apply for an irrigation using soil, plant, or weather based measurements [water savings]	111	0.562	1.149	0.837	1.053
Q30BA. Measure the soil moisture in a field after irrigations to determine how effective they were. [energy/water savings]	110	0.632	1.096	0.231	0.784
Q30CA. For drip or micro-sprinkler systems: inspect, clean and replace defective emitters or sprinklers at least once per year. [water savings]	98	0.666	0.791	0.279	1.863
Q30DA. For impact sprinkler systems: replace worn nozzles at least once per year and use a mid-field mainline placement during the season. [water savings]	62	0.026	2.322	0.194	1.54
Q30EA. For drip and sprinkler systems: regularly monitor and adjust system pressures, clean in-line screens, and flush lines at least once a year. [water/energy savings]	97	0.844	1.148	0.222	2.455
Q30FA. For surface irrigation systems: shorten run lengths and/or convert from open ditches to gated pipe. [energy/water savings]	67	0.315	1.388	0.965	0.986
Q30GA. Do you grow crops that use less water, in other words, have you changed the crops you grow so that you use less water [energy/water savings]	111	0.97	0.983	0.273	1.831

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.39
Hypotheses 6 & 13: OLS Model Results

Independent Variables: How confident are you that the information provided by flow meters is accurate? <Q27> AND How confident are you in your ability to interpret changes in the readings from a flow meter? <Q28>					
Dependent Variable	**N**	**Independent Variable**	***p***	**Adjusted R-square**	**R-Square Change**
ttlbehv: total number of (sum of all) behavioral changes that were implemented	111	Q27	0.328	0.157	0.001
		Q28	0.634		0.005

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

4.3.8 Hypothesis 7

For this hypothesis, the relationship of level of confidence in the ability to interpret changes in the readings of a flow meter to whether one investigates how to maintain the efficiency of the pump or irrigation system was examined. This hypothesis only involved those with flow meters. The results of this hypothesis test are presented in Exhibit 4.40.

Exhibit 4.40
Hypothesis 7 Logistic Model Results

Independent Variable: How confident are you in your ability to interpret changes in the readings from a flow meter? <Q28>			
Dependent Variable	**N**	**Significance**	**Odds Ratio**
Q31: During the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your WATER USE?	112	0.726	0.943
Q32: During the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your ENERGY USE?	111	0.112	1.34

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Neither of these two models passed the basic threshold for statistical significance. Thus, based on these results, combined with the bivariate analyses presented earlier, the conclusion is that there is no support for this hypothesis.

4.3.9 Hypothesis 8

This analysis tested the proposition that if one can get a customer to the point of investigating how to maintain the efficiency of their pump or irrigation system with respect to water *and* energy use, then they are somewhat more likely to actually change their irrigation management or other pumping system related behavior.

To test each of these this hypotheses with respect to *water* use, eight separate models were estimated. In each model, the seven questions regarding behavioral changes that could improve the efficiency of the pumping or irrigation system were used as the dependent variable in a model. Each of these dependent variables was regressed on a number of independent variables, which included the key independent variable (e.g. During the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your water use) and a number of covariates (control variables) such as size of the farm, and type of irrigation. An eighth OLS regression model was estimated that used as the dependent variable the sum of those behavioral changes implemented (0 to 7) along with the same independent variables. A similar set of models were also estimated with the key independent variable being whether, in the last three years, one has looked into making any additional changes in the management of the irrigation system to minimize energy use.

The results of this hypothesis test are presented in Exhibit 4-41 through 4-44. With respect to water use, three logistic regression models had statistically significant results (two were weak and one was moderate). If, during the last three years, one has looked into making any additional changes in the management of the irrigation system to minimize water use, then the odds of determining how much water to apply for an irrigation using soil, plant, or weather based measurements increase by 1.88, the odds of measuring the soil moisture in a field after irrigations to determine how effective they were increase by 1.77, and the odds of regularly monitoring and adjusting system pressures, clean in-line screens, and flushing lines at least once a year increase 10.4.

The OLS model was also significant with an R-square of 0.345 and an incremental R-square of 0.033. Looking into making any additional changes in the management of your irrigation system to minimize water use increases the number of implemented behaviors by nearly one.

With respect to *energy* use, two logistic regression models showed statistically significant results (one was weak and one was moderate). If, during the last three years, one has looked into making any additional changes in the management of the irrigation system to minimize energy use, then the odds of determining how much water to apply for an irrigation using soil, plant, or weather based measurements increase by 1.82 and the odds of shortening run lengths and/or converting from open ditches to gated pipe increase by 2.45. However, the OLS model was not significant.

While the overall support for this hypothesis is quite weak, it is arguably moderate when one considers only water. This is consistent with other information provided by installers of flow meters who indicated the main benefits are that flow meters can be used to track water use and ensure that they are using the right amount of water.

Exhibit 4.41
Hypothesis 8: Logistic Model Results: Water Use

Independent Variable: During the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your WATER USE? <Q31>			
Dependent Variable	**N**	***p****	**Odds Ratio**
Q30AA. Determine how much water to apply for an irrigation using soil, plant, or weather based measurements [water savings]	219	0.065	1.878
Q30BA. Measure the soil moisture in a field after irrigations to determine how effective they were. [energy/water savings]	218	0.071	1.768
Q30CA. For drip or micro-sprinkler systems: inspect, clean and replace defective emitters or sprinklers at least once per year. [water savings]	167	0.330	2.264
Q30DA. For impact sprinkler systems: replace worn nozzles at least once per year and use a mid-field mainline placement during the season. [water savings]	101	0.655	0.806
Q30EA. For drip and sprinkler systems: regularly monitor and adjust system pressures, clean in-line screens, and flush lines at least once a year. [water/energy savings]	167	0.042	10.4
Q30FA. For surface irrigation systems: shorten run lengths and/or convert from open ditches to gated pipe. [energy/water savings]	142	0.785	1.12
Q30GA. Do you grow crops that use less water, in other words, have you changed the crops you grow so that you use less water [energy/water savings]	221	0.794	1.13

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.42
Hypothesis 8: OLS Model Results: Water Use

Independent Variable: During the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your WATER USE? <Q31>				
Dependent Variable	**N**	***p****	**Adjusted R-square**	**R-Square Change**
ttlbehv: total number of (sum of all) behavioral changes that were implemented	221	0.0009	0.345	0.033

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.43
Hypothesis 8 Logistic Model Results: Energy Use

Independent Variable: During the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your ENERGY USE? <Q32>			
Dependent Variable	**N**	***p****	**Odds Ratio**
Q30AA. Determine how much water to apply for an irrigation using soil, plant, or weather based measurements [water savings]	217	0.082	1.817
Q30BA. Measure the soil moisture in a field after irrigations to determine how effective they were. [energy/water savings]	216	0.725	1.12
Q30CA. For drip or micro-sprinkler systems: inspect, clean and replace defective emitters or sprinklers at least once per year. [water savings]	166	0.289	0.393
Q30DA. For impact sprinkler systems: replace worn nozzles at least once per year and use a mid-field mainline placement during the season. [water savings]	100	0.381	0.639
Q30EA. For drip and sprinkler systems: regularly monitor and adjust system pressures, clean in-line screens, and flush lines at least once a year. [water/energy savings]	166	0.638	0.652
Q30FA. For surface irrigation systems: shorten run lengths and/or convert from open ditches to gated pipe. [energy/water savings]	142	0.035	2.446
Q30GA. Do you grow crops that use less water, in other words, have you changed the crops you grow so that you use less water [energy/water savings]	219	0.907	0.945

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.44
Hypothesis 8 OLS Model Results: Energy Use

Independent Variable: During the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your ENERGY USE? <Q32>				
Dependent Variable	**N**	***p***	**Adjusted R-square**	**R-Square Change**
ttlbehv: total number of (sum of all) behavioral changes that were implemented	219	0.374	0.301	0.011

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

4.3.10 Hypothesis 9

This analysis tested the proposition that if one can get a customer to the point of investigating how to maintain the efficiency of their pump or irrigation system, then they are somewhat more likely to actually make *hardware* changes that improve the efficiency of their pumping system with respect to water *and* energy use.

To test each of these this hypotheses with respect to *water* use, eight separate models were estimated. In each model, the seven questions regarding hardware changes that could improve the efficiency of the pumping or irrigation system were used as the dependent variable in a model. Each of these dependent variables was regressed on a number of independent variables, which included the key independent variable (e.g. During the last three years, have you looked into making any additional hardware changes to minimize your *water* use) and a number of covariates (control variables) such as size of the farm, and type of irrigation. An eighth OLS regression model was estimated that used as the dependent variable the sum of those hardware changes implemented (0 to 7) along with the same independent variables. A similar set of models were also estimated with the key independent variable being whether, in the last three years, one has looked into making any additional hardware changes to minimize *energy* use.

The results of this hypothesis test are presented in Exhibit 4.45 through Exhibit 4-48. With respect to water use, two logistic regression models indicated statistically significant results (one was strong and one was moderate). If, during the last three years, one has looked into making any additional hardware changes to minimize water use, then the odds of:

- changing hardware configurations based on an irrigation system evaluation increase by 2.47, and
- the odds of regularly adjusting bowls on deep well pumps increase by 1.89.

The OLS model was also significant with an R-square of 0.208 and an incremental R-square of 0.011. Looking into making any additional hardware changes to minimize water use increases the number of implemented hardware changes by nearly one half of a behavior.

With respect to energy use, four logistic regression models showed statistically significant results (one was strong, one was moderate, and two were weak). If, during the last three years, one has looked into making any additional hardware changes to minimize energy use, then the odds of:

- converting from open ditch to gated pipe or sprinkler irrigation increase by 1.67,

- changing hardware configurations based on an irrigation system evaluation increase by 2.76,
- installing additional pressure gauges at equipment stations for drip or sprinkler systems increase by 1.86,
- regularly adjusting bowls on deep well pumps increase by 2.21.

The OLS model was also significant with an R-square of 0.225 and an incremental R-square of 0.028. Looking into making any additional hardware changes to minimize water use increases the number of implemented hardware changes per grower increases by nearly 0.60. Put another way, , for every ten growers, there are an additional 6 behaviors that are implemented.

Taking all these results into account, the support for this hypothesis is moderate.

Exhibit 4.45
Hypothesis 9: Logistic Model Results: Water Use

Independent Variable: During the last three years, have you looked into making any additional hardware changes to minimize your WATER USE? <Q33>			
Dependent Variable	**N**	***p****	**Odds Ratio**
29BA. Did you install and use tools or instruments to measure soil moisture in the field [energy/water savings]	218	0.577	1.2
29CA. Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season [energy/water savings]	211	0.313	1.422
29DA. Did you convert from open ditch to gated pipe or sprinkler irrigation [energy/water savings]	211	0.585	1.2
29EA. Did you change hardware configurations based on an irrigation system evaluation [energy/water savings]	200	0.004	2.473
29FA. Did you install additional pressure gauges at equipment stations for drip or sprinkler systems [energy/water savings]	208	0.21	1.6
29GA. Did you replace or rebuild the bowels on deep well pumps [energy savings]	201	0.879	0.941
29HA. Did you regularly adjust bowels on deep well pumps [energy savings]		0.06	1.89

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.46
Hypothesis 9: OLS Model Results: Water Use

Dependent Variable	N	*p**	Adjusted R-square	R-Square Change
ttlhrdw: Indicates the total number of (sum of all) hardware changes that were implemented	220	0.032	0.208	0.011

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.47
Hypothesis 9: Logistic Model Results: Energy

Independent Variable: During the last three years, have you looked into making any additional hardware changes to minimize your ENERGY USE? <Q34>			
Dependent Variable	**N**	***p****	**Odds Ratio**
29BA. Did you install and use tools or instruments to measure soil moisture in the field [energy/water savings]	219	0.822	1.073
29CA. Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season [energy/water savings]	212	0.541	1.222
29DA. Did you convert from open ditch to gated pipe or sprinkler irrigation [energy/water savings]	202	0.1	1.674
29EA. Did you change hardware configurations based on an irrigation system evaluation [energy/water savings]	212	0.001	2.758
29FA. Did you install additional pressure gauges at equipment stations for drip or sprinkler systems [energy/water savings]	201	0.08	1.858
29GA. Did you replace or rebuild the bowels on deep well pumps [energy savings]	209	0.447	1.336
29HA. Did you regularly adjust bowels on deep well pumps [energy savings]	202	0.017	2.21

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.48
Hypothesis 9: OLS Model Results: Energy Use

Independent Variable: During the last three years, have you looked into making any additional hardware changes to minimize your ENERGY USE? <Q34>				
Dependent Variable	**N**	***p****	**Adjusted R-square**	**R-Square Change**
ttlhrdw: Indicates the total number of (sum of all) hardware changes that were implemented	221	0.004	0.225	0.028

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

4.3.11 Hypothesis 10

This is one of the key hypotheses since it relates to the effect of installing flow meters with respect to hardware changes. A presentation of the bivariate analyses is presented first and then a presentation of the multiple regression analyses.

The results of the initial examination of this hypothesis are presented in Exhibit 4.49. This table presents data that compares the percentage of respondents that implemented the indicated behavioral changes listed in column one, for those that have flow meters installed and those that do not have flow meters installed. The percentages in column two are for those with flow meters; the percentages in column three are for those without flow meters. The value in column four is the mean rating reported by flow meter installers as to the level of influence having a flow meter had on the decision to implement the indicated behavioral change. The influence rating is based on a scale of one to seven, with one meaning ‘Not at All Influential’ and seven meaning ‘Very Influential’. The last three columns present the results of the bivariate analysis that tests whether the observed relationships between the respective dependent variables (Q29BA – Q29GA) and the independent variable, whether or not a respondent installed a flow meter, is significant. Column five shows the value of the Chi-Square statistic, column six shows the significance of the Chi-Square statistic, and the final column shows the strength of the relationship indicated in the bivariate analysis by the Somers’ d statistic. The cases for which the value of the Chi-Square statistic is significant are marked with an asterisk. Somer’s D is a statistic that measures the strength of the relationship between two variables. It ranges from -1, indicating perfect negative relationship to +1, indicating a perfect positive relationship.

Exhibit 4.49
Chi-Square Analyses: Hardware Changes

	Did you Install a Flow Meter?					
	Yes	No				
Dependent Variable	Percent of Installers Who Took Indicated Action	Percent of Non-Installers Who Took Indicated Action	Influence of Flow Meter	Chi - Square	*p*	Strength of Relationship (Somer's D)
29BA. Did you install and use tools or instruments to measure soil moisture in the field [energy/water savings]	28.9	19.1	3.27	9.381	0.002*	0.195
29CA. Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season [energy/water savings]	25.2	23.5	2.80	0.269	0.604	0.034
29DA. Did you convert from open ditch to gated pipe or sprinkler irrigation [energy/water savings]	18.7	15.6	2.76	1.272	0.259	0.071
29EA. Did you change hardware configurations based on an irrigation system evaluation [energy/water savings]	21.6	19.9	3.49	0.279	0.597	0.034
29FA. Did you install additional pressure gauges at equipment stations for drip or sprinkler systems [energy/water savings]	29.0	17.9	3.60	7.411	0.006*	0.182
29GA. Did you replace or rebuild the bowls on deep well pumps [energy savings]	29.4	37.3	4.14	1.012	0.314	0.055
29HA. Did you regularly adjust bowls on deep well pumps [energy savings]	17.9	16.2	3.73	0.103	0.749	0.020

*Significant at less than 0.01 level.

Of the seven relationships examined, the Chi-square statistic is significant for two of them. A larger proportion of those with flow meters:

- installed and used tools or instrument to measure soil moisture in the field, and
- installed additional pressure gauges at equipment stations for drip or sprinkler systems.

However, having a statistically significant chi-square only indicates that the observed relationship was beyond chance. However, it says nothing about the *strength* of the relationship, which is measured by the Somer's D statistic. It is possible that while the Chi-square is statistically significant, the strength of the relationship is so small that it is of no practical significance to program managers. With this in mind, the Somer's D ranges range from a negative 0.020 to a positive 0.195. These results suggest that flow meters are not very influential in the decisions to make these hardware changes. The self-reported influence of the flow meter in making these hardware changes also support this conclusion with an average of 3.40 means (on the 7-point scale) across all seven hardware changes.

While the relationships of individual variables to whether pumping system and irrigation hardware changes were examined in previous sections, it is always useful to examine the relationships of all these variables simultaneously in a multivariate logistic regression analysis where the effects of the other variables can be statistically controlled. In such an environment, previously undetected relationships might emerge while other previously observed relationships might disappear. Therefore, logistic regression models were formulated to explain why customers decide to make behavioral changes that improve the efficiency of their pumping or irrigation system.

To test each of these this hypotheses, eight separate models were estimated. In each model, the seven questions regarding hardware changes that could improve the efficiency of the pumping or irrigation system were used as the dependent variable in a model. Each of these dependent variables was regressed on a number of independent variables, which included the key independent variable (e.g., Percent of Pumps with Working Flow Meters) and a number of covariates (control variables) such as size of the farm, and type of irrigation. An eighth OLS regression model was estimated that used as the dependent variable the sum of those hardware changes implemented (0 to 7) along with the same independent variables.

The multivariate models that control for other variables (the covariates) indicate no statistically significant results. In addition, the OLS results confirm the results of the logistic regression model.

Exhibit 4.50
Hypothesis 10: Logistic Model Results

Independent Variable: Percent of Pumps with Working Flow Meters Installed <pwrkgfm4>			
Dependent Variable	**N**	***p****	**Odds Ratio**
29BA. Did you install and use tools or instruments to measure soil moisture in the field [energy/water savings]	216	0.16	1.005
29CA. Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season [energy/water savings]	209	0.15	0.994
29DA. Did you convert from open ditch to gated pipe or sprinkler irrigation [energy/water savings]	199	0.47	1.003
29EA. Did you change hardware configurations based on an irrigation system evaluation [energy/water savings]	209	0.69	1.001
29FA. Did you install additional pressure gauges at equipment stations for drip or sprinkler systems [energy/water savings]	198	0.69	0.998
29GA. Did you replace or rebuild the bowels on deep well pumps [energy savings]	206	0.38	0.996
29HA. Did you regularly adjust bowels on deep well pumps [energy savings]	199	0.81	1.001

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.51
Hypothesis 10: OLS Model Results

Independent Variable: Percent of Pumps with Working Flow Meters Installed <pwrkgfm4>				
Dependent Variable	**N**	***p****	**Adjusted R-square**	**R-Square Change**
ttlhrdw: Indicates the total number of (sum of all) hardware changes that were implemented	218	0.70	0.200	0.005

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

4.3.12 Hypothesis 11

Hypothesis 11 is that increased awareness of water and energy use causes a grower to make hardware changes that improve the efficiency of their pumping system.

To test each of these this hypotheses with respect to *water* use, eight separate models were estimated. In each model, the seven questions regarding hardware changes that could improve the efficiency of the pumping or irrigation system were used as the dependent variable in a model. Each of these dependent variables was regressed on a number of independent variables, which included the key independent variable (e.g. awareness of the amount of water used in pumps) and a number of covariates (control variables) such as size of the farm, and type of irrigation. An eighth OLS regression model was estimated that used as the dependent variable the sum of those hardware changes implemented (0 to 7) along with the same independent variables. A similar set of models were also estimated with the key independent variable being whether, in the last three years, one has looked into making any hardware changes in the management of the irrigation system to minimize *energy* use.

The results of this hypothesis test are presented in Exhibit 4-52 through Exhibit 4-55. With respect to water use, two logistic regression models showed statistically significant results (both were moderate). As awareness of water use in pumps increases, the odds of:

- Replacing or rebuilding the bowls on deep well pumps increases by 1.37, and
- Regularly adjusting bowls on deep well pumps increases by 1.44.

In addition, the OLS model did not produce statistically significant results.

With respect to energy use, two logistic regression models showed statistically significant results (one was weak and one was moderate). As awareness of water use in pumps increases, the odds of:

- Installing and using tools or instruments to measure soil moisture in the field increases by 1.23, and
- Regularly adjusting bowls on deep well pumps increases by 1.30.

In addition, the OLS model did not produce statistically significant results.

Considering these results, there is no support for this hypothesis.

Exhibit 4.52
Hypothesis 11 Logistic Model Results: Awareness of Water Use

Independent Variable: How aware are you of the AMOUNT OF WATER used by your pumps? <Q3>			
Dependent Variable	**N**	***p***	**Odds Ratio**
29BA. Did you install and use tools or instruments to measure soil moisture in the field [energy/water savings]	226	0.938	1.008
29CA. Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season [energy/water savings]	219	0.216	0.866
29DA. Did you convert from open ditch to gated pipe or sprinkler irrigation [energy/water savings]	208	0.458	1.093
29EA. Did you change hardware configurations based on an irrigation system evaluation [energy/water savings]	217	0.725	1.039
29FA. Did you install additional pressure gauges at equipment stations for drip or sprinkler systems [energy/water savings]	208	0.867	1.02
29GA. Did you replace or rebuild the bowls on deep well pumps [energy savings]	216	0.019	1.37
29HA. Did you regularly adjust bowls on deep well pumps [energy savings]	209	0.011	1.437

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.53
Hypothesis 11: OLS Model Results: Awareness of Water Use

Independent Variable: How aware are you of the AMOUNT OF WATER used by your pumps? <Q3>				
Dependent Variable	**N**	***p***	**Adjusted R-square**	**R-Square Change**
ttlhrdw: Indicates the total number of (sum of all) hardware changes that were implemented	228	0.202	0.202	0.011

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.54
Hypothesis 11: Logistic Model Results: Awareness of Energy Use

Independent Variable: How aware are you of the AMOUNT OF ENERGY used by your pumps? <Q4>			
Dependent Variable	**N**	***p***	**Odds Ratio**
29BA. Did you install and use tools or instruments to measure soil moisture in the field [energy/water savings]	227	0.052	1.226
29CA. Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season [energy/water savings]	220	0.259	0.885
29DA. Did you convert from open ditch to gated pipe or sprinkler irrigation [energy/water savings]	209	0.771	1.034
29EA. Did you change hardware configurations based on an irrigation system evaluation [energy/water savings]	218	0.645	1.048
29FA. Did you install additional pressure gauges at equipment stations for drip or sprinkler systems [energy/water savings]	209	0.277	0.884
29GA. Did you replace or rebuild the bowels on deep well pumps [energy savings]	217	0.743	0.96
29HA. Did you regularly adjust bowels on deep well pumps [energy savings]	210	0.034	1.303

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.55
Hypothesis 11: Logistic Model Results: Awareness of Energy Use

Independent Variable: How aware are you of the AMOUNT OF ENERGY used by your pumps? <Q4>				
Dependent Variable	**N**	***p***	**Adjusted R-square**	**R-Square Change**
ttlhrdw: Indicates the total number of (sum of all) hardware changes that were implemented	229	0.283	0.198	0.007

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

4.3.13 Hypothesis 12 and 14

The hypotheses tested were that growers who are confident in the accurate reading of the flow meter *and* who are confident in their ability to interpret changes in the reading of a flow meter are more likely to make hardware changes that improve the efficiency of their pumping system. The results of these hypothesis tests are presented in Exhibit 4.56 and Exhibit 4.57.

To test each of these this hypotheses, eight separate models were estimated. In each model, the seven questions regarding hardware changes that could improve the efficiency of the pumping or irrigation system were used as the dependent variable in a model. Each of these dependent variables was regressed on a number of independent variables, which included the key independent variable (e.g., Confidence in the Accurate Reading of the Flow Meter *and* Confidence in their Ability to Interpret Changes in the Reading of a Flow Meter) and a number of covariates (control variables) such as size of the farm, and type of irrigation. An eighth OLS regression model was estimated that used as the dependent variable the sum of those hardware changes implemented (0 to 7) along with the same independent variables.

Of the seven models, only one produced statistically significant results with the correct sign. As one's confidence increases in their ability to interpret changes in the readings from a flow meter, the odds of replacing or rebuilding the bowls on deep well pumps increase by 1.9. The OLS model also failed to produce statistically significant results.

Based on these results, there is no support for this hypothesis.

Exhibit 4.56
Hypotheses 12 and 14: Logistic Model Results

Independent Variables: How confident are you that the information provided by flow meters is accurate? <Q27> AND How confident are you in your ability to interpret changes in the readings from a flow meter? <Q28>

		Q27		Q28	
Dependent Variable	**N**	***p****	**Odds Ratio**	***p****	**Odds Ratio**
29BA. Did you install and use tools or instruments to measure soil moisture in the field [energy/water savings]	111	0.857	1.037	0.072	0.656
29CA. Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season [energy/water savings]	107	0.754	0.935	0.239	1.33
29DA. Did you convert from open ditch to gated pipe or sprinkler irrigation [energy/water savings]	99	0.974	1.006	0.487	1.16
29EA. Did you change hardware configurations based on an irrigation system evaluation [energy/water savings]	108	0.902	0.978	0.774	0.946
29FA. Did you install additional pressure gauges at equipment stations for drip or sprinkler systems [energy/water savings]	107	0.032	0.559	0.35	1.286
29GA. Did you replace or rebuild the bowels on deep well pumps [energy savings]	105	0.359	0.739	0.071	1.941
29HA. Did you regularly adjust bowels on deep well pumps [energy savings]	n/a	n/a	n/a	n/a	n/a

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

Exhibit 4.57
Hypotheses 12 and 14: Logistic Model Results

Independent Variables: How confident are you that the information provided by flow meters is accurate? <Q27> AND How confident are you in your ability to interpret changes in the readings from a flow meter? <Q28>					
Dependent Variable	**N**	**Independent Variable**	***p****	**Adjusted R-square**	**R-Square Change**
ttlhrdw: Indicates the total number of (sum of all) hardware changes that were implemented	111	Q27	0.263	0.255	0.002
		Q28	0.573		0.004

*Light gray indicates weak support, medium gray indicates moderate support, dark gray indicates strong support for the hypothesis. Clear indicates no support of the hypothesis.

5 Findings and Recommendations

This section summarizes the results presented in Section 4 and makes recommendations as to whether flow meters should be included within any energy efficiency program whose goals are to reduce energy use at the pump for agricultural customers.

5.1 Summary of Results

5.1.1 Flow Meter Users

Users give moderate high ratings of their confidence in the *accuracy* of information provided by the flow meter, and their *ability to interpret* changes in the flow meter readings.

Nearly 96% of the growers indicate that they use their flow meters and, of these, 92% indicate that they do something with this information. Respondents indicated the main benefits are that flow meters can be used to track water use and ensure that they are using enough water. Some also indicated that flow meters help to maintain the efficiency of their pumps and to reduce the cost of operating their pumps. Overall, the survey results for those with flow meters seem to point to a need for an educational program component regarding the benefits of using flow meters, to ensure that growers understand how to use the flow meter information and that the flow meter can be used to decrease the cost of operating their pumping system.

5.1.2 Hypotheses Tests

This study has provided much useful information. Exhibit 5.1 summarizes the primary findings relating to the tested hypotheses that are presented in Section 4.3. Also, recall that five of the hypotheses (1, 2, 8, 9, and 11) involve both a water use component and an energy use component. For these hypotheses, separate models for the water use component of the hypothesis and separate models for the energy use component of the hypothesis were estimated. Thus, counting these sub-hypotheses, 19 hypotheses overall were tested. Thus, the words “Energy” and/or “Water” appear in cells for those hypotheses which had a water and energy component.

Exhibit 5.1
Summary of Study Findings

No.	Hypothesis	None	Weak	Moderate	Strong
1	Growers who install flow meters are more aware of the water and energy used by their pumps.	X (Energy)		X (Water)	
2	Increased awareness of water flow rates causes a grower to change their irrigation management or other pumping system related behavior.	X (Energy)	X (Water)		
3	Cost is a major barrier to the installation of flow meters. (i.e., installing piping to obtain accurate reading of the flow of the water).				X
4	Growers who install flow meters are more likely to make changes to their irrigation management or other pumping system related behavior.		X		

No.	Hypothesis	None	Weak	Moderate	Strong
5	Growers who believe that a flow meter can reduce operating costs are more likely to install a flow meter.				X
6	Growers who are confident in the accurate reading of the flow meter will be more likely to change their irrigation management or other pumping system related behavior.		X		
7	Growers who understand how to interpret the changes of flow meter readings are more likely to investigate how to maintain the efficiency of the pump or the irrigation system.	X			
8	Growers who investigate how to maintain the efficiency of the pump or the irrigation system are more likely to change their irrigation management or other pumping system related behavior.		X (Energy)	X (Water)	
9	Growers who investigate how to maintain the efficiency of the pump or the irrigation system are more likely to make hardware changes that improve the efficiency of their pumping system.			X (Water & Energy)	
10	Growers who install flow meters are more likely to make hardware changes that improve the efficiency of their pumping system.	X			
11	Increased awareness of water and energy use causes a grower to make hardware changes that improve the efficiency of their pumping system.		X (Water & Energy)		
12	Growers who are confident in the accurate reading of the flow meter will be more likely to make hardware changes that improve the efficiency of their pumping system.	X			
13	Growers who understand how to interpret the changes of flow meter readings are more likely to change their irrigation management or other pumping system related behavior.	X			
14	Growers who understand how to interpret the changes of flow meter readings are more likely to make hardware changes that improve the efficiency of their pumping system.	X			

For the 19 hypotheses tested, there was no support for 7, weak support for 6, moderate support for 4, and strong support for 2. While the installation of flow meters has little effect with respect to <u>overall</u> behavior and hardware changes, it does have an impact on <u>specific</u> behaviors. As the percent of pumps with working flow meters increases, the odds of:

1. determining how much water to apply for an irrigation using soil, plant, or weather based measurements increases by 1.009, and
2. regularly monitoring and adjusting system pressures, cleaning in-line screens, and flushing lines at least once a year increases by 1.034.

Unfortunately, because these are rather small increases in the odds, reallocating a relatively large fraction of scarce program funds to implement strategies to increase the penetration of flow meters is very likely not cost-effective.

Hypotheses 4 and 10 were considered primary since, if the benefits of flow meters could not be established, then factors that increase their adoption and use are of little interest. Thus, the weak support for Hypothesis 4 and no support for Hypothesis 10 is particularly troublesome.

There are two possible explanations for the results reported in this study regarding the effects of flow meters on these behavioral and hardware changes.

1. *The information provided by flow meters does not play a significant role in making any of the behavioral and hardware changes that were the primary focus of this study*. <u>OR</u>
2. *The information provided by flow meters does play a role in making the behavioral and hardware changes that were the focus of this study*. However, because the agricultural sector, like any business, is complex, decisions regarding such important issues as the crops one chooses to grow, capital investments, and operation and maintenance practices are the result of a number of interrelated factors. Thus, while flow meters can provide important information, there are many other and potentially more important factors that drive such decisions. To be able to tease out the effects of flow meters from this complex web of more important factors might require more accurate information on a larger number of variables for a larger sample of farms that was possible given both budget and time constraints.

While the analysis supports the first explanation, there are a variety of factors that could have made it difficult to detect the true impact of low meters, including:

- measurement error (e.g., the tendency of growers to under- or over-estimate the number of pumps or the number of pumps with working flow meters),
- omission of relevant variables (i.e., those that could help explain variations in the dependent variable) which were difficult to obtain and incorporate into a model such as the annual water used in irrigation and the annual energy consumed by the pumps as a percent of total energy used by the farm, and
- data problems (e.g., collinearity, complete- and quasi-separation[6] for logistic models).

It is also possible that there is the *potential* for flows meters to impact such decisions. The analysis shows that nearly 96% of the growers with flow meters indicate that they use their flow meters and, of these, 92% indicate that they do something with this information, although not in ways that would affect the behaviors and hardware changes that were the focus of this study. Thus, it might be that growers still do not appreciate the wide range of behavior and hardware decisions that can be better informed with information provided by flow meters. Until they do, the information provided by flow meters will be underused. This suggests the possible need for

[6] This is a type of numerical problem in which a collection of covariate separates the outcome groups perfectly. For example, suppose that the installation of flow meters is trying to be predicted. Suppose further that all of those who installed flow meters were large farms and all of those who did not install flow metes were medium farms. Thus, if the size of the farm was known then whether they have installed a flow meter is also known. In such a situation, solutions for logistic models do not exist and the model must be re-specified.

more education about the wide range of behavior and hardware decisions that can be better informed with information provided by flow meters.

5.1.3 Recommendations

Based on these analyses, it appears premature to recommend that a full educational component focusing on flow meters be added to the APEP or to provide incentives for the purchase of flow meters. However, the weak support for Hypothesis 4 along with the survey results support continuing to educate growers about flow meters. Growers tend to identify with potential water savings that can be associated with information from flow meters since water applications have a direct relationship to the performance and yields of corps. Energy used to provide the water is one step removed from the growth of crops. Therefore, educational efforts must be much more intensive in the use of flow meter information to better manage and reduce energy use through management of water use since grower do not have a “mind-set” that relates energy use to crop production. Based on the analysis of the other hypotheses, education materials should stress that the installation of flow meters can reduce operating costs. This is particularly important since cost is one of the major barriers to the installation of flow meters and reduced operating costs can help to reduce the payback on such a purchase. In addition, these materials could also stress that there are a large number of behavioral and hardware changes that can be better informed using information provided by flow meters. Finally, water use appears to be a more important factor than energy use in the decision to install flow meters. Therefore, while not ignoring the energy benefits, stressing in these educational materials the reduction of water use is recommended.

If there is a decision to investigate flow meters further, it might be useful to conduct a more rigorous experimental test of the effect of flow meters. A small experiment could be conducted in which growers without flow meters are randomly assigned to two groups. One group would be given flow meters and the other group would not. A simple comparison of behaviors and hardware changes made during the course of the experiment could then be conducted to determine the effect of flow meters.

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APPENDIX B – Survey Instrument

Hello, my name is____ from XXXX**.** I am calling on behalf of the Agricultural Pumping Efficiency Program. Have I reached _____? May I speak with ___________, or with the person who was responsible for overseeing your irrigation system.

We are asking growers such as you to help us learn more about irrigation system practices within California. The survey should take about 15 minutes and your responses will be kept confidential. Is now a good time?

Reschedule to different time: _______________

Awareness & Confidence – Water and Energy

I would like to ask you a few questions about water and energy use. These questions can be answered on a scale of 1 to 7.

1. How important is it for you to be sure that your pumping system makes <u>efficient use of energy</u>? On a scale of 1 to 7, a 1 means “Not At All Important” and a 7 means “Very Important”.

___ Response .... (1-7)

___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

2. On this same scale, how important is it for you to be sure that your pumping system makes <u>efficient use of water</u>?

___ Response .... (1-7)

___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

3. How aware are you of the <u>amount of water used</u> by your pumps? On a scale of 1 to 7, with a 1 meaning “Not At All Aware” and a 7 meaning “Very Aware”. [Hyp #1; Hyp #2; Hyp #11].

___ Response .... (1-7)

___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

4. How aware are you of the <u>amount of energy used</u> by your pumps? Again, a rating of 1 means “Not At All Aware” and a 7 means “Very Aware”, [Hyp #1; Hyp #2; Hyp #11].

___ Response .... (1-7)

___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

5. Do you record the energy used by your pump(s) in terms of kilowatt-hours from the utility's meter? [Awareness of energy use; Hyp #1; Hyp #2; Hyp #11]
   Yes 1
   No ....2 (Skip to Q7)
   Don't know (**DO NOT READ**) ....(-8) (Skip to Q7)
   Refused (**do not read**) ....(-9) (Skip to Q7)

6. How often do you write down the total kWh information? [Awareness of energy use; Hyp #1; Hyp #2; Hyp #11]
   - After every irrigation? 1
   - Once per month? 2
   - At the beginning and end of the irrigation season? 3
   - Once per year? 4
   - Some other frequency? Please Specify____________ 5
   - Don't know (**DO NOT READ**)..(-8)
   - Refused (**DO NOT READ**) ....(-9)

Established Practices

7. Does your organization have established practices for maintaining the efficiency of your pumping system? These practices might include regular adjustments of pump bowels, annual pump testing, and routine recording of pump flow rates. [Prior EE behavior]

   Yes 1
   No ....2 (Skip to Q9)
   Don't know (**DO NOT READ**) ....(-8) (Skip to Q9)
   Refused (**DO NOT READ**)...(-9) (Skip to Q9)

8. How long have these practices been in place? [Prior EE behavior]

   Approximate # of years (months): ....______ years (months).
   Don't know (**DO NOT READ**) ....(-8)
   Refused (**DO NOT READ**) ....(-9)

9. Does your organization have established practices for maintaining their irrigation system other than the pumping system? For drip and micro-irrigation systems, these practices might include regular system pressure checks and line flushing plus periodic evaluations of system efficiency. [Prior water efficiency/management behavior]

   Yes 1
   No ....2 (Skip to Q11)
   Don't know (**DO NOT READ**) ....(-8) (Skip to Q11)
   Refused (**DO NOT READ**)...(-9) (Skip to Q11)

10. How long have these practices been in place? [Prior water efficiency/management behavior]

    Approximate # of years (months):........................______ years (months).
    Don't know (**DO NOT READ**)..(-8)
    Refused (**DO NOT READ**) ....(-9)

11. On a scale of 1 to 7, with a 1 meaning "Not At All Certain" and a 7 meaning "Very Certain", how certain are you that flow meters can assist growers to reduce the operating costs of their pumps? [Hyp #5].

___ Response .... (1-7)

___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

12. Of all the farming operations that you know about, approximately what percent have installed flow meters on at least some of their pumps? [Baseline assessment of flow meter penetration]

___ Percent..........................___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

[IF GREATER THAN 0 PERCENT, ASK: Approximately, what percent of these farms do you think use the information provided by flow meters at least some of the time?]

___ Percent..........................___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

13. Do you have a flow meter installed on any of the pumps in your farming operation? [Installer? Y/N; Hyp #1; Hyp #4; Hyp #5; Hyp #10]

    Yes...1
    No ....2 (skip to Q29)
    Don't know (**DO NOT READ**)...(-8) (skip to Q29)
    Refused (**DO NOT READ**) ....(-9) (skip to Q29)

14. Approximately what percent of your pumps have flow meters installed? [Baseline assessment of flow meter use]

___ Percent..........................___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

IF 0 PERCENT THEN GO TO Q30; OTHERWSE CONTINUE

14A. Are of the flow meters functioning?

14B. Approximately what percent are not functioning?

15. Approximately how long ago were most of the flow meters installed? [Baseline assessment of flow meter use/practices]

Within the last year 1
Within the last two to three years 2
Within the last four to five years...3
More than five years 4
Don't know (**DO NOT READ**)...(-8)
Refused (**DO NOT READ**) ....(-9)

16. Were you or your company responsible for making the decision to install these flow meters? [Actual installer is more likely to use the flow meter]

Yes...1
No 2
No, they were already installed when I purchased the business or was hired by the company 3
Don't know (**DO NOT READ**)...(-8)
Refused (**DO NOT READ**) ....(-9)

17. In your experience, what are the benefits of using a flow meter? [Baseline assessment of flow meter use/practices/awareness]

Please explain: ___________________________________

If believe there are no benefits, skip to Q19

18. How did you learn about the benefits of installing/using a flow meter? (**READ**) [Impact of APEP Education/Means of learning about flow meters] MR

APEP Program..1
It is a long-time farming practice 2
Utility Representative 3
Word of Mouth 4
Pump Test Company 5
Other (Please Specify) ________________________________ 6
Don't know (**DO NOT READ**)...(-8)
Refused (**DO NOT READ**) ....(-9)

19. On our scale of 1 to 7, with a 1 meaning "Never" and a 7 meaning "Consistently", how often do you use information from a flow meter? [Use of flow meter information].

___ Response ....(1-7)

___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

READ - Most flow meters have two different readings – one giving the current flow rate when the pump is operating, and one showing the total flow volume to date. The next set of questions asks about only the flow rate when the pump is operating.

20. How often do you look at the current reading on your flow meter(s) during the irrigation season? (**READ**) [Use of flow meter info; Hyp #?]

Never..1 (skip to Q23)
After every irrigation?...2
Once per month?...3
At the beginning and end of the irrigation season?..........................4
Once per year? 5
Some other frequency? Please Specify_____________ 6
Don't know (**DO NOT READ**)..(-8)
Refused (**DO NOT READ**) ....(-9)

21. Do you record the flow rate on a regular basis? [Use of flow meter info; Hyp #?]

Yes..1
No ....2 (skip to Q23)
Don't know (**DO NOT READ**)..(-8) (skip to Q23)
Refused (**DO NOT READ**) ....(-9) (skip to Q23)

22. How often do you record the flow rate? (**READ**) [Use of flow meter info; Hyp #?]

After every irrigation?...1
Once per month?...2
At the beginning and end of the irrigation season?..........................3
Once per year? 4
Some other frequency? Please Specify_____________ 5
Don't know (**DO NOT READ**)..(-8)
Refused (**DO NOT READ**) ....(-9)

23. When you notice a change in the flow rate, what do you do with that information? [Use of flow meter info; Hyp #?] MR

Contact your pump dealer?...1
Contact your electric utility representative? 2
Contact a pump tester?..3
Record the reading for future reference?. 4
Nothing, just remember when it changed. 5
Other? Please Specify_____________ 6
Don't know (**DO NOT READ**)..(-8)
Refused (**DO NOT READ**) ....(-9)

READ - The next couple questions are now about the total volume of water pumped.

24. For the total volume reading from your flow meter(s), do you write down the number? [Use of flow meter info; Hyp #?]

Yes..1
No ....2 (skip to Q27)
Don't know (**DO NOT READ**)..(-8) (skip to Q27)
Refused (**DO NOT READ**) ....(-9) (skip to Q27)

25. How often do you write down the total volume information? (**READ**) [Use of flow meter info; Hyp #?]

    After every irrigation? 1
    Once per month? 2
    At the beginning and end of the irrigation season? 3
    Once per year? 4
    Some other frequency? Please Specify_____________ 5
    Don't know (**DO NOT READ**).. (-8)
    Refused (**DO NOT READ**) .... (-9)

If yes on Q5 and Q24 then ask Q26.

26. Using the total volume of water pumped and the total kilowatt-hours consumed, do you calculate the kilowatt-hours used per acre-foot of water pumped? [Use of flow meter info; Awareness of energy and water use; Hyp #?]

    Yes 1
    No 2
    Don't know (**DO NOT READ**).. (-8)
    Refused (**DO NOT READ**) .... (-9)

27. On a scale of 1 to 7, with a 1 meaning "Not At All Confident" and a 7 meaning "Very Confident", how confident are you that the information provided by flow meters is accurate? [Hyp #6; Hyp #12].

___ Response .... (1-7) ___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

28. With that same seven-point scale, how confident are you in your ability to interpret changes in the readings from a flow meter? [Hyp #7; Hyp #13; Hyp #14].

___ Response .... (1-7) ___ Don't know (**DO NOT READ**) (-8) ___ Refused (**DO NOT READ**) (-9)

CHANGES IN IRRIGATION HARDWARE

29. I am going to read you some possible changes you may have made in your irrigation system. Please tell me which of the following <u>hardware changes</u> have you made to <u>minimize your use of water and energy use</u>? [Baseline assessment of pumping system efficiency changes/behaviors; Hyp #9; Hyp #10; Hyp #11; Hyp #12; Hyp #14]

FOR EACH YES:

ASK: Approximately how long ago did you make this hardware change?

IF Q13=1, PROBE: On a scale of 1 to 7, with a 1 meaning "Not At All Influential" and a 7 meaning "Very Influential," to what extent was this hardware change influenced by information provided by flow meters?

Hardware Changes	Yes (1)	No (2)	NA (3)	DK (-8)	REF (-9)	How long ago	Influence of Flow Meter
Install and use tools or instruments to measure soil moisture in the field [energy/water savings]							
Convert from surface to drip or sprinkler irrigation for some or all irrigations during the season [energy/water savings]							
Convert from open ditch to gated pipe or sprinkler irrigation [energy/water savings]							
Change hardware configurations based on an irrigation system evaluation [energy/water savings]							
Install additional pressure gauges at equipment stations for drip or sprinkler systems [energy/water savings]							
Replace or rebuild the bowels on deep well pumps [energy savings]							
Regularly adjust bowels on deep well pumps [energy savings]							

CHANGES IN IRRIGATION MANAGEMENT PRACTICES

30. Now I'm going to read you a number of irrigation management practices. Please tell me which of the following do you follow routinely. READ [Baseline assessment of irrigation mgmt practices; Hyp #2; Hyp #4; Hyp #6; Hyp #8; Hyp #13]

FOR EACH YES:

ASK: Approximately how long ago did you begin this practice?

IF Q13 =1, PROBE: On a scale of 1 to 7, with a 1 meaning "Not At All Influential" and a 7 meaning "Very Influential," to what extent was the initiation of this practice influenced by the information provided by flow meters?

Practice	Yes (1)	No (2)	NA* (3)	DK (-8)	REF (-9)	How long ago	Influence of Flow Meter
Determine how much water to apply for an irrigation using soil, plant, or weather based measurements [water savings]							
Measure the soil moisture in a field after irrigations to determine how effective they were. [energy/water savings]							
For drip or micro-sprinkler systems: inspect, clean and replace defective emitters or sprinklers at least once per year. [water savings]							
For impact sprinkler systems: replace worn nozzles at least once per year and use a mid-field mainline placement during the season. [water savings]							
For drip and sprinkler systems: regularly monitor and adjust system pressures, clean in-line screens, and flush lines at least once a year. [water/energy savings]							
For surface irrigation systems: shorten run lengths and/or convert from open ditches to gated pipe. [energy/water savings]							
Have you changed the crops you grow so that you use less water [energy/water savings]							
*NA – not applicable because farmer does not have that type of irrigation system.							

Investigation of Changes in Management Practices

31. Other than what we have discussed, during the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your water use? [Hyp #7; Hyp #8; Hyp #9]

    Yes..1
    No 2
    Don't know (**DO NOT READ**)...(-8)
    Refused (**DO NOT READ**) ....(-9)

32. Other than what we have discussed, during the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your energy use? [Hyp #7; Hyp #8; Hyp #9]

Yes..1
No 2
Don't know (**DO NOT READ**)...(-8)
Refused (**DO NOT READ**) ....(-9)

Investigation of Changes in Hardware

33. Other than what we have discussed, during the last three years, have you looked into making any additional hardware changes to minimize your water use? [Hyp #7; Hyp #8; Hyp #9]

Yes..1
No 2
Don't know (**DO NOT READ**)...(-8)
Refused (**DO NOT READ**) ....(-9)

34. Other than what we have discussed, during the last three years, have you looked into making any additional hardware changes to your pumping system to minimize your energy use? [Hyp #7; Hyp #8; Hyp #9]

Yes..1
No 2
Don't know (**DO NOT READ**)...(-8)
Refused (**DO NOT READ**) ....(-9)

IF Q 13 =2 CONTINUE; ELSE GO TO Q36

BARRIERS

35. What are the primary reasons why you have not installed flow meters on your pumps? [Do not read; mark all that apply] [Barriers/ Hyp #3].

Cost...1
Lack of awareness...2
Lack of information about flow meters.......................................3
Don’t believe flow meters are beneficial 4
Distrust of how the information could be used by the Government 5
Don’t think they are accurate...6
Require too much time to read regularly and record 7
They are too difficult to interpret...8
My piping configuration does not work well with flow meters 9
Other (Please Specify) ________________________________ 10
Don't know (**DO NOT READ**)...(-8)
Refused (**DO NOT READ**) ....(-9)

FIRMOGRAPHIC INFORMATION

READ: Now, I have a last set of general questions about your business or organization.

36. Which of the following is your largest source of revenue? (**READ ENTIRE LIST; CODE ONLY ONE THAT BEST FITS**)? [Firmographic info]

    Vegetables or field crops 1
    Livestock 2
    Ornamental nursery....................3
    Indoor crops (greenhouse) 4
    Packing plant....................5
    Vineyard/winery 6
    Orchard....................7
    Dairy farm 8
    Water district/services....................9
    Other? (**SPECIFY**) ________________ ..10
    Don't know (**DO NOT READ**)....................(-8)
    Refused (**DO NOT READ**) ....(-9)

37. Does your farming operation or organization own the land that you farm or where pumps are operating? [Firmographic info]

    Yes, we own all of the land....................1
    Yes, we own a part of the land....................2
    No, we do not own any of the land 3
    Don't know (**DO NOT READ**)....................(-8)
    Refused (**DO NOT READ**)....................(-9)

38. Would you consider your business or organization operated by a family or a company or government entity? [Firmographic info]

    Family....................1
    Company....................2
    Government Entity 3
    Not applicable....................4
    Don't know (**DO NOT READ**)....................(-8)
    Refused (**DO NOT READ**)....................(-9)

39. Comparing your farming operation or organization to others that are similar to yours, would you categorize yourself as small, medium or large? [Firmographic info]

    Small....................1
    Medium 2
    Large 3
    Don't know (**DO NOT READ**)....................(-8)

Refused (**DO NOT READ**)...(-9)

40. How long has your farming operation or organization been operating at its current location? (**READ LIST**) [Firmographic info]

1 to 3 years...1

4 to 10 years...2

More than 10 years...3

Don't know (**DO NOT READ**)...(-8)

Refused (**DO NOT READ**)...(-9)

41. Approximately how many water pumps are used in your operation? (**NUMBER OF PUMPS**) [Firmographic info]

___ Number of Pumps
___ Don't know (**DO NOT READ**)(-8)
___ Refused (**DO NOT READ**) (-9)

42. Of these pumps, approximately how many are electric, natural gas, or diesel? (**NUMBER OF PUMPS**) [Firmographic info]

42A. Number of Electric Pumps... ______
42B. Number of Natural Gas Pumps... ______
42C. Number of Diesel Pumps .... ______
Don't know (**DO NOT READ**)...(-8)
Refused (**DO NOT READ**)...(-9)

43. What is your estimate of the average age of the pump(s)? [Firmographic info]

Average # of years: ______ years old
Range of years _____________range
Don't know (**DO NOT READ**)...(-8)
Refused (**DO NOT READ**)...(-9)

44. On average, how many months are the pumps used during the year? (**READ LIST**) [Firmographic info]

Less than 3 months...1
3-6 months...2
7-9 months...3
10 months -Year round 4
Don't know (**DO NOT READ**)...(-8)
Refused (**DO NOT READ**)...(-9)

45. Which type of irrigation system do you use for the majority of the pumps at your site? [Firmographic info]

Drip 1

Sprinkler 2
Flood/Furrow..3
Other (**SPECIFY**) ______________________ 4
Don't know (**DO NOT READ**) ....(-8)
Refused (**DO NOT READ**)...(-9)

46. Approximately, what percentage of your total annual operating costs would you estimate is spent in <u>energy</u> bills? [Firmographic info]

Approximate % (**OR RECORD RANGE**): ...._____%
Don't know (**DO NOT READ**) ....(-8)
Refused (**DO NOT READ**)...(-9)

47. Approximately, what percentage of your total annual operating costs is spent in <u>water</u> bills? [Firmographic info]

Approximate % (**OR RECORD RANGE**): ...._____%
Don't know (**DO NOT READ**) ....(-8)
Refused (**DO NOT READ**)...(-9)

THANK YOU FOR YOUR TIME, THAT COMPLETES OUR SURVEY.

APPENDIX C – Survey Frequencies

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					
	Yes			No		
Question	**Mean**	**Standard Error of Mean**	**Valid N**	**Mean**	**Standard Error of Mean**	**Valid N**
<q1> How important is it for you to be sure that your pumping system makes efficient use of energy?	6.55	0.08	N=124	6.52	0.09	N=125
<q2> How important is it for you to be sure that your pumping system makes efficient use of water	6.65	0.06	N=124	6.55	0.08	N=125
<q3> How aware are you of the AMOUNT OF WATER USED by your pumps?	6.08	0.11	N=121	5.79	0.13	N=124
<q4> How aware are you of the AMOUNT OF ENERGY USED by your pumps?	5.67	0.13	N=122	5.88	0.14	N=124
<q8YRS> How long have these practices been in place (unit of time in years)	12.61	1.2	N=90	16.51	1.92	N=64
<q10YRS> How long have these practices been in place (unit of time in years)	12.46	0.81	N=105	15.94	1.56	N=83

Question	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					
	Yes			No		
	Mean	Standard Error of Mean	Valid N	Mean	Standard Error of Mean	Valid N
<q11> How certain are you that flow meters can assist growers to reduce the operating costs of their pumps?	5.19	0.16	N=122	4.1	0.21	N=115
<q12> Of all the farming operations that you are aware of, approximately what percent have installed flow meters on at least some of their pumps?	48.19	3.42	N=97	10.08	1.79	N=95
<q12A> Approximately what percent of these farms do you think use the information provided by flow meters at least some of the time?	69.31	3.35	N=84	47.82	4.88	N=38
<q14> Approximately what percent of your pumps have flow meters installed?	60.44	3.34	N=122	NA	NA	N=0
<q14B:HOWMANY> What percentage of your flow meters are currently NOT functioning?	40.29	10.97	N=7	NA	NA	N=0
<q19> How often do you use information from a flow meter?	5.41	0.15	N=124	NA	NA	N=0
<q27> How confident are you that the information provided by flow meters is accurate?	5.51	0.13	N=123	NA	NA	N=0
<q28> How confident are you in your ability to interpret changes in the	5.58	0.14	N=121	NA	NA	N=0

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					
	Yes			No		
Question	Mean	Standard Error of Mean	Valid N	Mean	Standard Error of Mean	Valid N
readings from a flow meter?						
<q29bbYRS> How long ago did you make this change (unit of time in years)	8.61	0.83	N=67	7.99	1.3	N=45
<q29bc> How influential was the information provided by the flow meter(s) in your starting this practice: installing and using tools...?	3.27	0.28	N=70	NA	NA	N=0
<q29cbYRS> How long ago did you make this change (unit of time in years)	10.4	0.99	N=57	8.95	1.09	N=55
<q29cc> How influential was the information provided by the flow meter(s) in your starting this practice: converting from surface to drip or sprinkler...?	2.8	0.3	N=59	NA	NA	N=0
<q29dbYRS> How long ago did you make this change (unit of time in years)	17.21	2.36	N=39	13.99	2.15	N=31
<q29dc> How influential was the information provided by the flow meter(s) in your starting this practice: converting from open ditch to gated pipe or sprinkeler...?	2.76	0.37	N=42	1.00	NA	N=1

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					
	Yes			No		
Question	**Mean**	**Standard Error of Mean**	**Valid N**	**Mean**	**Standard Error of Mean**	**Valid N**
<q29ebYRS> How long ago did you make this change (unit of time in years)	9.01	1.38	N=49	5.23	0.86	N=46
<q29ec> How influential was the information provided by the flow meter(s) in your starting this practice: change hardware configurations...?	3.49	0.37	N=51	NA	NA	N=0
<q29fbYRS> How long ago did you make this change (unit of time in years)	9.77	1.47	N=63	6.76	0.88	N=39
<q29fc> How influential was the information provided by the flow meter(s) in your starting this practice: installing additional pressure gauges...?	3.6	0.3	N=65	NA	NA	N=0
<q29gbYRS> How long ago did you make this change (unit of time in years)	11.26	2.31	N=79	5.17	0.73	N=85
<q29gc> How influential was the information provided by the flow meter(s) in your starting this practice: replacing or rebuiling the bowls...?	4.14	0.28	N=92	1.00	NA	N=1

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					
	Yes			No		
Question	**Mean**	**Standard Error of Mean**	**Valid N**	**Mean**	**Standard Error of Mean**	**Valid N**
<q29hbYRS> How long ago did you make this change (unit of time in years)	11.91	3.13	N=36	10.1	2.3	N=33
<q29hc> How influential was the information provided by the flow meter(s) in your starting this practice: regularly adjust bowls...?	3.73	0.43	N=40	NA	NA	N=0
<q30abYRS> How long ago did you make this change (unit of time in years)	11.85	1.13	N=92	10.25	1.07	N=63
<q30ac> How influential was the information provided by the flow meter(s) in your starting this practice: installing and using tools...?	2.87	0.23	N=97	NA	NA	N=0
<q30bbYRS> How long ago did you make this change (unit of time in years)	10.06	0.91	N=70	7.58	1.06	N=44
<q30bc> How influential was the information provided by the flow meter(s) in your starting this practice: installing and using tools...?	2.96	0.27	N=72	NA	NA	N=0
<q30cbYRS> How long ago did you make this change (unit of time in years)	13.16	1.31	N=88	9.89	0.97	N=64

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					
	Yes			No		
Question	**Mean**	**Standard Error of Mean**	**Valid N**	**Mean**	**Standard Error of Mean**	**Valid N**
<q30cc> How influential was the information provided by the flow meter(s) in your starting this practice: converting from surface to drip or sprinkler...?	2.85	0.21	N=95	NA	NA	N=0
<q30dbYRS> How long ago did you make this change (unit of time in years)	18.09	3.09	N=32	12.94	2.08	N=16
<q30dc> How influential was the information provided by the flow meter(s) in your starting this practice: converting from open ditch to gated pipe or sprinkeler...?	3.06	0.4	N=34	NA	NA	N=0
<q30ebYRS> How long ago did you make this change (unit of time in years)	12.67	1.05	N=92	10.63	0.94	N=67
<q30ec> How influential was the information provided by the flow meter(s) in your starting this practice: change hardware configurations...?	3.09	0.23	N=99	NA	NA	N=0
<q30fbYRS> How long ago did you make this change (unit of time in years)	17.5	2.25	N=30	14.72	1.87	N=38

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					
	Yes			No		
Question	Mean	Standard Error of Mean	Valid N	Mean	Standard Error of Mean	Valid N
<q30fc> How influential was the information provided by the flow meter(s) in your starting this practice: installing additional pressure gauges...?	2.71	0.39	N=35	1.00	NA	N=1
<q30gbYRS> How long ago did you make this change (unit of time in years)	15.58	2.53	N=12	14.68	2.79	N=17
<q30gc> How influential was the information provided by the flow meter(s) in your starting this practice: replacing or rebuiling the bowls...?	2.23	0.61	N=13	NA	NA	N=0
<q41> Approximately how many water pumps are used in your operation?	21.69	3.42	N=123	6.61	0.82	N=124
<q42A> Number of electric pumps?	17.85	2.85	N=123	5.68	0.68	N=124
<q42B> Number of natural gas pumps?	0.54	0.16	N=124	0.02	0.01	N=124
<q42C> Number of diesel pumps?	2.86	0.88	N=124	0.87	0.24	N=124
<q43age> What is your estimate of the average age of the pumps (in years, with midpoints given for ranges)	16.02	0.93	N=120	18.46	1.33	N=119

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					
	Yes			No		
Question	Mean	Standard Error of Mean	Valid N	Mean	Standard Error of Mean	Valid N
<q46> Approximately what percentage of your total annual operating costs would you estimate is spent in ENERGY BILLS?	16.22	1.71	N=90	15.93	1.47	N=87
<q47> Approximately what percentage of your total annual operating costs would you estimate is spent in WATER BILLS?	10.43	1.51	N=90	7.31	0.98	N=94

		<q13> Do you have a flow meter installed on any of the pumps in your farming operation?				Total	
		Yes		No			
Question	Response	Count	%	Count	%	Count	%
<q5> Do you record the energy used by your pump(s) in terms of kWh from the utility meter?	Yes	N=40	32.50%	N=30	24.60%	N=70	28.60%
	No	N=83	67.50%	N=92	75.40%	N=175	71.40%
<q7> Does your organization have established practices for maintaining the efficiency of your pumping system?	Yes	N=93	75.60%	N=65	52.00%	N=158	63.70%
	No	N=30	24.40%	N=60	48.00%	N=90	36.30%
<q9> Does your organization have established practices for maintaining their irrigation system other than the pumping system?	Yes	N=108	87.80%	N=83	66.90%	N=191	77.30%
	No	N=15	12.20%	N=41	33.10%	N=56	22.70%
<q16> Were you or your company responsible for making the decision to install these flow meters?	Yes, I was responsible	N=101	82.10%	N=0	0.00%	N=101	82.10%
	No-neither was responsible	N=14	11.40%	N=0	0.00%	N=14	11.40%
	NO, meters installed when I purchased business or before my company purchased the business	N=8	6.50%	N=0	0.00%	N=8	6.50%

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?					Total	
		Yes		No		Count	%
Question	Response	Count	%	Count	%		
<q14A:WORKING> Are all of these flow meters currently functioning?	Yes	N=115	94.30%	N=0	0.00%	N=115	94.30%
	No	N=7	5.70%	N=0	0.00%	N=7	5.70%
<Q21> Do you record the flow rate on a regular basis?	Yes	N=48	40.30%	N=0	0.00%	N=48	40.30%
	No	N=71	59.70%	N=0	0.00%	N=71	59.70%
<q24> For the total volume reading from your flow meter(s), do you write down the number?	Yes	N=81	65.30%	N=0	0.00%	N=81	65.30%
	No	N=43	34.70%	N=0	0.00%	N=43	34.70%
<q26> Using the total volume of water pumped and the total kWh consumed, do you calculate the kWh used per acre-foot of water pumped?	Yes	N=24	80.00%	N=0	0.00%	N=24	80.00%
	No	N=6	20.00%	N=0	0.00%	N=6	20.00%
<q29ba> Did you install and use tools or instruments to measure soil moisture in the field?	Yes	N=71	57.70%	N=47	38.20%	N=118	48.00%
	No	N=52	42.30%	N=76	61.80%	N=128	52.00%
<q29ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?	Yes	N=60	50.40%	N=56	47.10%	N=116	48.70%
	No	N=59	49.60%	N=63	52.90%	N=122	51.30%
<q29da> Did you convert from open ditch to gated pipe or sprinkler irrigation?	Yes	N=42	37.80%	N=35	30.70%	N=77	34.20%
	No	N=69	62.20%	N=79	69.30%	N=148	65.80%

		<q13> Do you have a flow meter installed on any of the pumps in your farming operation?				Total	
		Yes		No		Count	%
Question	**Response**	**Count**	**%**	**Count**	**%**		
<q29ea> Did you change hardware configurations based on an irrigation system evaluation?	Yes	N=51	43.20%	N=47	39.80%	N=98	41.50%
	No	N=67	56.80%	N=71	60.20%	N=138	58.50%
<q29fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?	Yes	N=65	55.60%	N=40	37.40%	N=105	46.90%
	No	N=52	44.40%	N=67	62.60%	N=119	53.10%
<q29ga> Did you replace or rebuild the bowls on deep well pumps?	Yes	N=93	79.50%	N=88	73.90%	N=181	76.70%
	No	N=24	20.50%	N=31	26.10%	N=55	23.30%
<q29ha> Did you regularly adjust bowls on deep well pumps?	Yes	N=41	35.00%	N=37	33.00%	N=78	34.10%
	No	N=76	65.00%	N=75	67.00%	N=151	65.90%
<q30aa> Did you install and use tools or instruments to measure soil moisture in the field?	Yes	N=99	80.50%	N=71	57.70%	N=170	69.10%
	No	N=24	19.50%	N=52	42.30%	N=76	30.90%
<q30ba> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?	Yes	N=75	61.50%	N=47	38.20%	N=122	49.80%
	No	N=47	38.50%	N=76	61.80%	N=123	50.20%
<q30ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?	Yes	N=98	96.10%	N=67	89.30%	N=165	93.20%
	No	N=4	3.90%	N=8	10.70%	N=12	6.80%
<q30da> Did you convert from open ditch to gated pipe or sprinkler irrigation?	Yes	N=34	52.30%	N=17	38.60%	N=51	46.80%

		<q13> Do you have a flow meter installed on any of the pumps in your farming operation?				Total	
		Yes		No			
Question	Response	Count	%	Count	%	Count	%
	No	N=31	47.70%	N=27	61.40%	N=58	53.20%
<q30ea> Did you change hardware configurations based on an irrigation system evaluation?	Yes	N=101	96.20%	N=70	88.60%	N=171	92.90%
	No	N=4	3.80%	N=9	11.40%	N=13	7.10%
<q30fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?	Yes	N=35	46.70%	N=43	50.00%	N=78	48.40%
	No	N=40	53.30%	N=43	50.00%	N=83	51.60%
<q30ga> Did you replace or rebuild the bowls on deep well pumps?	Yes	N=14	11.40%	N=17	13.70%	N=31	12.60%
	No	N=109	88.60%	N=107	86.30%	N=216	87.40%
<q31> During the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your WATER USE?	Yes	N=78	62.90%	N=67	53.60%	N=145	58.20%
	No	N=46	37.10%	N=58	46.40%	N=104	41.80%
<q32> During the past three years, have you looked into making any additional changes in the management of your ENERGY USE?	Yes	N=83	67.50%	N=70	56.50%	N=153	61.90%
	No	N=40	32.50%	N=54	43.50%	N=94	38.10%
<q33> Within the last year, have you looked into making any additional hardware changes to minimize your WATER USE?	Yes	N=65	52.80%	N=57	45.60%	N=122	49.20%
	No	N=58	47.20%	N=68	54.40%	N=126	50.80%

Question	Response	<q13> Do you have a flow meter installed on any of the pumps in your farming operation? — Yes Count	Yes %	No Count	No %	Total Count	Total %
<q34> Within the last year, have you investigated any additional hardware changes to your pumping system to minimize your ENERGY USE?	Yes	N=69	55.60%	N=53	42.40%	N=122	49.00%
	No	N=55	44.40%	N=72	57.60%	N=127	51.00%

Question	<q13> Do you have a flow meter installed on any of the pumps in your farming operation? — Yes: <q6> How often do you write down the total kWh information from the utility meter? Count	Yes %	No: <q6> How often do you write down the total kWh information from the utility meter? Count	No %
After every irrigation	N=1	2.60%	N=0	0.00%
Once per month	N=23	59.00%	N=20	66.70%
At the beginning and end of the irrigation season	N=3	7.70%	N=0	0.00%
Once per year	N=7	17.90%	N=7	23.30%
Some other frequency- SPECIFY	N=5	12.80%	N=3	10.00%

Question	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?			
	Yes		No	
	<q6> How often do you write down the total kWh information from the utility meter?		<q6> How often do you write down the total kWh information from the utility meter?	
	Count	%	Count	%
Total	N=39	100.00%	N=30	100.00%

Question	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?			
	Yes		No	
	<q15> Approximately how long ago were most of the flow meters installed?		<q15> Approximately how long ago were most of the flow meters installed?	
	Count	%	Count	%
Within the last year	N=5	4.10%	NA	NA
Within the last 2 to 3 years	N=26	21.10%	NA	NA
Within the last 4 to 5 years	N=30	24.40%	NA	NA
More than five years ago	N=62	50.40%	NA	NA
Total	N=123	100.00%	NA	NA

Question	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?			
	Yes		No	
	<Q20> How often do you look at the current reading on your flow meter(s) during the irrigation season?		<Q20> How often do you look at the current reading on your flow meter(s) during the irrigation season?	
	Count	%	Count	%
Never	N=5	4.00%	NA	NA
After every irrigation	N=29	23.40%	NA	NA
Once per month	N=28	22.60%	NA	NA
At the beginning and end of the irrigation season	N=4	3.20%	NA	NA
Once per year	N=4	3.20%	NA	NA
Some other frequency -SPECIFY	N=54	43.50%	NA	NA
Total	N=124	100.00%	NA	NA

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?							
	Yes				No			
Question	<Q22> How often do you record the flow rate?		<q25> How often do you write down the total volume information?		<Q22> How often do you record the flow rate?		<q25> How often do you write down the total volume information?	
	Count	%	Count	%	Count	%	Count	%
After every irrigation	N=9	18.80%	N=11	13.60%	NA	NA	NA	NA
Once per month	N=18	37.50%	N=34	42.00%	NA	NA	NA	NA
At the beginning and end of the irrigation season	N=1	2.10%	N=10	12.30%	NA	NA	NA	NA
Once per year	N=2	4.20%	N=14	17.30%	NA	NA	NA	NA
Some other frequency- SPECIFY	N=18	37.50%	N=12	14.80%	NA	NA	NA	NA
Total	N=48	100.00%	N=81	100.00%	NA	NA	NA	NA

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?			
	Yes		No	
Question	<q38> Would you consider your business or organization operated by a family or a company or government entity?		<q38> Would you consider your business or organization operated by a family or a company or government entity?	
	Count	%	Count	%
Family	N=95	77.20%	N=115	92.00%
Company	N=26	21.10%	N=10	8.00%
Government Entity	N=2	1.60%	N=0	0.00%
Total	N=123	100.00%	N=125	100.00%

Question	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?			
	Yes		No	
	<q39> Comparing your farming operation or organization to others similar to yours, would you categorize yourself as small, medium or large?		<q39> Comparing your farming operation or organization to others similar to yours, would you categorize yourself as small, medium or large?	
	Count	%	Count	%
Small	N=35	28.20%	N=67	53.60%
Medium	N=53	42.70%	N=50	40.00%
Large	N=36	29.00%	N=8	6.40%
Total	N=124	100.00%	N=125	100.00%

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?			
	Yes		No	
Question	<q40> How long has your farming operation or organization been operating at its current location?		<q40> How long has your farming operation or organization been operating at its current location?	
	Count	%	Count	%
1 to 3 years	N=1	0.80%	N=8	6.50%
4 to 10 years	N=12	9.70%	N=8	6.50%
More than 10 years	N=111	89.50%	N=108	87.10%
Total	N=124	100.00%	N=124	100.00%

	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?			
	Yes		No	
Question	<q44> On average, how many months are the pumps used during the year?		<q44> On average, how many months are the pumps used during the year?	
	Count	%	Count	%
Less than 3 months	N=7	5.60%	N=13	10.40%
3 to 6 months	N=59	47.60%	N=68	54.40%
7 to 9 months	N=40	32.30%	N=36	28.80%
10 Months to Year around	N=18	14.50%	N=8	6.40%
Total	N=124	100.00%	N=125	100.00%

Question	<q13> Do you have a flow meter installed on any of the pumps in your farming operation?			
	Yes		No	
	<q45> Which type of irrigation system do you use for the majority of the pumps at your site?		<q45> Which type of irrigation system do you use for the majority of the pumps at your site?	
	Count	%	Count	%
Drip	N=48	38.70%	N=29	23.20%
Sprinkler	N=30	24.20%	N=28	22.40%
Flood/Furrow	N=32	25.80%	N=60	48.00%
OTHER - SPECIFY	N=14	11.30%	N=8	6.40%
Total	N=124	100.00%	N=125	100.00%

Q18: How did you learn about the benefits of flow meters?		
Response	**Count**	**Column %**
<q18c01> APEP Program	4	3.30%
<q18c02> It is a long-time farming practice	26	21.30%
<q18c03> Utility Representative	2	1.60%
<q18c04> Word of Mouth	9	7.40%
<q18c05> Pump Test Company	8	6.60%
<q18c06> Trade Publication	7	5.70%
<q18c07> Through an agricultural organization	12	9.80%
<q18c77> Other	66	54.10%
<q18c99> Dont Know	3	2.50%
Total	122	100.00%

Q23: What do with the FM info when there is a change in the FR?		
Response	**Count**	**Column %**
<q23c01> Contact your pump dealer	12	9.70%
<q23c02> Contact your electric utility rep	1	0.80%
<q23c03> Contact a pump dealer	10	8.10%
<q23c04> Record the reading for future reference	3	2.40%
<q23c05> Nothing, just remember when it changed	10	8.10%
<q23c77> Other	89	71.80%
<q23c99> Dont Know	4	3.20%
Total	124	100.00%

Q35: What are the Barriers to Installing a Flow Meter?		
Response	**Count**	**Column %**
<q35c01> Cost	25	20.20%
<q35c02> Lack of awareness	8	6.50%
<q35c03> Lack of information about flow meters	8	6.50%
<q35c04> Distrust of how the information could be used by the Government	15	12.10%
<q35c05> My piping configuration does not work well with flow meters	4	3.20%
<q35c06>: Don't think they are accurate	0	0%
<q35c07>: Require too much time to read regularly and record	0	0%
<q35c08>: They are too difficult to inerpret	0	0%
<q35c09>: My piping configuration does not work well with flow meters	1	0.80%
<q35c77> Other	79	63.70%
<q35c99> Dont Know	11	8.90%
Total	124	100.00%

APPENDIX D – Detailed Regression Results

The information in this appendix provides the detailed results of each of the final regression models used in the analysis of the various hypotheses. Interested parties can contact Equipoise Consulting if they would like clarification of any parameters.

Hypothesis 1

The REG Procedure

Dependent Variable: Q3 <q3> How aware are you of the AMOUNT OF WATER USED by your pumps?

Number of Observations Read	249.000
Number of Observations Used	217.000
Number of Observations with Missing Values	32.000

R-Square	0.101
Adj R-Sq	0.029
Dependent Mean	5.959
Coeff Var	22.463

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
PWRKGFM4	0.005	0.002	2.170	0.031
OWNALL	0.192	0.231	0.830	0.407
LARGE	-0.168	0.300	-0.560	0.576
MEDIUM	-0.405	0.221	-1.830	0.068
CROPS	-0.030	0.284	-0.110	0.916
DAIRYFM	0.105	0.455	0.230	0.818
LIVESTK	-0.454	0.481	-0.940	0.346
ORCHARD	0.132	0.257	0.510	0.609
FLDFRRW	0.159	0.256	0.620	0.534
SPRNKLR	0.490	0.271	1.810	0.072
FAMOWN	0.256	0.259	0.990	0.325
Q43AGE	0.006	0.008	0.810	0.420
Q9	0.233	0.253	0.920	0.358
Q11	0.033	0.049	0.670	0.502
OVERTEN	0.234	0.290	0.810	0.420
Q41	-0.001	0.003	-0.360	0.721

Hypothesis 1

The REG Procedure

Dependent Variable: Q4 <q4> How aware are you of the AMOUNT OF ENERGY USED by your pumps?

Number of Observations Read	249.000
Number of Observations Used	218.000
Number of Observations with Missing Values	31.000

R-Square	0.151
Adj R-Sq	0.083
Dependent Mean	5.780
Coeff Var	24.468

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
PWRKGFM4	0.000	0.002	-0.020	0.981
OWNALL	0.341	0.242	1.410	0.160
LARGE	-0.251	0.316	-0.800	0.427
MEDIUM	-0.401	0.232	-1.730	0.085
CROPS	0.358	0.300	1.190	0.234
DAIRYFM	0.218	0.481	0.450	0.651
LIVESTK	0.641	0.508	1.260	0.208
ORCHARD	0.501	0.271	1.850	0.066
FLDFRRW	0.289	0.268	1.080	0.283
SPRNKLR	0.072	0.287	0.250	0.803
FAMOWN	0.452	0.274	1.650	0.100
Q43AGE	0.010	0.008	1.230	0.219
Q9	0.419	0.267	1.570	0.118
Q11	0.058	0.051	1.140	0.256
OVERTEN	0.587	0.307	1.920	0.057
Q41	0.003	0.004	0.750	0.457

Hypothesis 2a

The LOGISTIC Procedure

Response Variable	Q30AA

<q30aa> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	217.000

Probability Modeled Is Q30AA='1'.

R-Square	0.148	**Max-rescaled R-Square**	0.212

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	34.675	14.000	0.002
Score	33.815	14.000	0.002
Wald	28.041	14.000	0.014

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	1.667	1.139	2.141	0.143
Q3	0.041	0.127	0.106	0.745
OWNALL	0.284	0.414	0.470	0.493
CROPS	-0.016	0.504	0.001	0.975
DAIRYFM	-0.766	0.698	1.203	0.273
LIVESTK	-1.071	0.815	1.729	0.189
ORCHARD	0.500	0.482	1.077	0.299
FLDFRRW	-1.065	0.447	5.683	0.017
SPRNKLR	-0.372	0.515	0.520	0.471
FAMOWN	0.256	0.452	0.320	0.572
Q43AGE	-0.003	0.014	0.044	0.834
Q9	-0.621	0.402	2.387	0.122
Q11	0.151	0.085	3.172	0.075
OVERTEN	-0.957	0.615	2.428	0.119
Q41	0.008	0.010	0.713	0.398

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	1.042	0.812	1.338
OWNALL	1.328	0.590	2.992
CROPS	0.985	0.366	2.645
DAIRYFM	0.465	0.118	1.827
LIVESTK	0.343	0.069	1.691
ORCHARD	1.649	0.641	4.242
FLDFRRW	0.345	0.144	0.828
SPRNKLR	0.690	0.251	1.894
FAMOWN	1.292	0.532	3.135
Q43AGE	0.997	0.971	1.024
Q9	0.537	0.244	1.182
Q11	1.163	0.985	1.373
OVERTEN	0.384	0.115	1.280
Q41	1.008	0.989	1.028

Hypothesis 2a

The LOGISTIC Procedure

Response Variable	Q30BA

<q30ba> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	216.000

Probability Modeled Is Q30BA='1'.

R-Square	0.172	**Max-rescaled R-Square**	0.229

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	40.691	14.000	0.000
Score	36.147	14.000	0.001
Wald	28.694	14.000	0.012

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	0.974	1.014	0.924	0.337
Q3	0.077	0.113	0.469	0.493
OWNALL	0.209	0.387	0.291	0.590
CROPS	0.115	0.462	0.062	0.803
DAIRYFM	-0.141	0.708	0.040	0.842
LIVESTK	-1.962	1.153	2.894	0.089
ORCHARD	0.519	0.412	1.583	0.208
FLDFRRW	-0.792	0.408	3.767	0.052
SPRNKLR	-0.308	0.438	0.494	0.482
FAMOWN	-0.022	0.403	0.003	0.957
Q43AGE	0.004	0.013	0.096	0.757
Q9	-1.104	0.422	6.829	0.009
Q11	0.118	0.077	2.324	0.127
OVERTEN	-0.903	0.502	3.230	0.072
Q41	0.014	0.009	2.297	0.130

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	1.080	0.866	1.347
OWNALL	1.232	0.577	2.629
CROPS	1.122	0.454	2.777
DAIRYFM	0.868	0.217	3.476
LIVESTK	0.141	0.015	1.348
ORCHARD	1.679	0.749	3.766
FLDFRRW	0.453	0.204	1.008
SPRNKLR	0.735	0.312	1.733
FAMOWN	0.978	0.444	2.157
Q43AGE	1.004	0.979	1.029
Q9	0.332	0.145	0.759
Q11	1.125	0.967	1.308
OVERTEN	0.405	0.151	1.085
Q41	1.014	0.996	1.034

Hypothesis 2a

The LOGISTIC Procedure

Response Variable	Q30CA

<q30ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	158.000

Probability Modeled Is Q30CA='1'.

R-Square	0.076	**Max-rescaled R-Square**	0.213

Testing Global Null Hypothesis: BETA=0

Test	**Chi-Square**	**DF**	**Pr > Chi Sq**
Likelihood Ratio	12.396	9.000	0.192
Score	13.757	9.000	0.131
Wald	10.551	9.000	0.308

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	3.595	2.417	2.211	0.137
Q3	-0.023	0.269	0.007	0.932
OWNALL	-1.314	1.018	1.665	0.197
CROPS	-2.118	0.907	5.454	0.020
FLDFRRW	-1.903	0.790	5.804	0.016
FAMOWN	0.696	0.978	0.506	0.477
Q43AGE	0.022	0.038	0.339	0.560
Q11	0.076	0.205	0.137	0.712
OVERTEN	0.102	1.204	0.007	0.932
Q41	0.021	0.031	0.449	0.503

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	0.977	0.577	1.656
OWNALL	0.269	0.037	1.977
CROPS	0.120	0.020	0.711
FLDFRRW	0.149	0.032	0.701
FAMOWN	2.005	0.295	13.638
Q43AGE	1.023	0.948	1.103
Q11	1.079	0.721	1.613
OVERTEN	1.108	0.105	11.722
Q41	1.021	0.961	1.085

Hypothesis 2a

The LOGISTIC Procedure

Response Variable	Q30DA

<q30da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	101.000

Probability Modeled Is Q30DA='1'.

R-Square	0.093	**Max-rescaled R-Square**	0.124

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	9.840	11.000	0.545
Score	9.430	11.000	0.582
Wald	8.641	11.000	0.655

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-0.961	1.523	0.398	0.528
Q3	0.064	0.172	0.137	0.711
OWNALL	-0.464	0.503	0.848	0.357
CROPS	0.641	0.526	1.487	0.223
FLDFRRW	-0.458	0.634	0.522	0.470
SPRNKLR	0.219	0.497	0.195	0.659
FAMOWN	0.236	0.551	0.183	0.669
Q43AGE	-0.006	0.019	0.091	0.763
Q9	-0.585	0.601	0.946	0.331
Q11	0.106	0.112	0.885	0.347
OVERTEN	1.025	0.704	2.119	0.145
Q41	-0.008	0.010	0.709	0.400

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	1.066	0.760	1.494
OWNALL	0.629	0.235	1.687
CROPS	1.899	0.678	5.321
FLDFRRW	0.633	0.183	2.190
SPRNKLR	1.245	0.471	3.295
FAMOWN	1.266	0.430	3.727
Q43AGE	0.994	0.957	1.033
Q9	0.557	0.172	1.810
Q11	1.112	0.892	1.386
OVERTEN	2.786	0.701	11.072
Q41	0.992	0.973	1.011

Hypothesis 2a

The LOGISTIC Procedure

Response Variable	Q30EA

<q30ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	166.000

Probability Modeled Is Q30EA='1'.

R-Square	0.163	**Max-rescaled R-Square**	0.446

Testing Global Null Hypothesis: BETA=0

Test	**Chi-Square**	**DF**	**Pr > Chi Sq**
Likelihood Ratio	29.589	11.000	0.002
Score	39.634	11.000	<.0001
Wald	17.511	11.000	0.094

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	6.363	2.924	4.735	0.030
Q3	-0.183	0.362	0.255	0.614
OWNALL	-1.291	1.033	1.562	0.211
CROPS	-2.576	0.970	7.049	0.008
FLDFRRW	-1.256	1.064	1.393	0.238
SPRNKLR	0.221	1.142	0.037	0.847
FAMOWN	0.119	1.342	0.008	0.929
Q43AGE	0.013	0.043	0.096	0.757
Q9	-2.852	0.961	8.814	0.003
Q11	0.305	0.224	1.848	0.174
OVERTEN	1.818	1.113	2.669	0.102
Q41	0.015	0.034	0.200	0.655

Odds Ratio Estimates

Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Q3	0.833	0.409	1.694
OWNALL	0.275	0.036	2.082
CROPS	0.076	0.011	0.509
FLDFRRW	0.285	0.035	2.293
SPRNKLR	1.247	0.133	11.697
FAMOWN	1.127	0.081	15.648
Q43AGE	1.013	0.931	1.103
Q9	0.058	0.009	0.379
Q11	1.356	0.874	2.104
OVERTEN	6.157	0.696	54.491
Q41	1.015	0.950	1.085

Hypothesis 2a

The LOGISTIC Procedure

Response Variable	Q30FA

<q30fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	140.000

Probability Modeled Is Q30FA='1'.

R-Square	0.157	**Max-rescaled R-Square**	0.210

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	23.926	14.000	0.047
Score	22.282	14.000	0.073
Wald	19.364	14.000	0.152

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-1.476	1.408	1.099	0.294
Q3	0.334	0.166	4.051	0.044
OWNALL	-0.045	0.467	0.009	0.924
CROPS	1.381	0.566	5.964	0.015
DAIRYFM	2.218	0.841	6.957	0.008
LIVESTK	1.587	0.896	3.140	0.076
ORCHARD	0.910	0.516	3.113	0.078
FLDFRRW	0.145	0.467	0.096	0.756
SPRNKLR	-0.429	0.609	0.494	0.482
FAMOWN	0.518	0.530	0.957	0.328
Q43AGE	-0.004	0.016	0.076	0.783
Q9	-0.859	0.472	3.314	0.069
Q11	-0.129	0.096	1.808	0.179
OVERTEN	-0.130	0.654	0.039	0.843
Q41	0.004	0.012	0.124	0.725

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	1.397	1.009	1.935
OWNALL	0.956	0.383	2.388
CROPS	3.979	1.314	12.053
DAIRYFM	9.188	1.768	47.744
LIVESTK	4.891	0.845	28.308
ORCHARD	2.485	0.904	6.831
FLDFRRW	1.156	0.463	2.890
SPRNKLR	0.651	0.197	2.151
FAMOWN	1.679	0.594	4.743
Q43AGE	0.996	0.965	1.027
Q9	0.423	0.168	1.068
Q11	0.879	0.728	1.061
OVERTEN	0.878	0.244	3.166
Q41	1.004	0.980	1.029

Hypothesis 2a

The LOGISTIC Procedure

Response Variable	Q30GA

<q30ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	219.000

Probability Modeled Is Q30GA='1'.

R-Square	0.090	**Max-rescaled R-Square**	0.174

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	20.661	14.000	0.111
Score	19.020	14.000	0.164
Wald	16.110	14.000	0.307

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-4.027	1.930	4.352	0.037
Q3	0.163	0.186	0.764	0.382
OWNALL	-0.597	0.516	1.338	0.247
CROPS	0.716	0.674	1.128	0.288
DAIRYFM	-0.623	1.218	0.262	0.609
LIVESTK	0.138	1.260	0.012	0.913
ORCHARD	0.681	0.628	1.174	0.279
FLDFRRW	0.754	0.558	1.829	0.176
SPRNKLR	-1.350	0.857	2.484	0.115
FAMOWN	1.618	1.052	2.365	0.124
Q43AGE	-0.023	0.022	1.168	0.280
Q9	-0.398	0.598	0.442	0.506
Q11	-0.056	0.109	0.263	0.608
OVERTEN	0.493	0.815	0.366	0.545
Q41	0.008	0.005	2.242	0.134

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	1.177	0.817	1.694
OWNALL	0.551	0.200	1.513
CROPS	2.045	0.546	7.662
DAIRYFM	0.536	0.049	5.830
LIVESTK	1.148	0.097	13.564
ORCHARD	1.975	0.577	6.769
FLDFRRW	2.126	0.713	6.342
SPRNKLR	0.259	0.048	1.389
FAMOWN	5.045	0.641	39.676
Q43AGE	0.977	0.937	1.019
Q9	0.672	0.208	2.170
Q11	0.946	0.764	1.171
OVERTEN	1.637	0.332	8.085
Q41	1.008	0.998	1.019

Hypothesis 2a

The REG Procedure

Dependent Variable: TTLBEHV <ttlbehv> Variable indicating the total number of behavioral changes that were implemented, with the maximum number possible being 7

Number of Observations Read	249.000
Number of Observations Used	220.000

R-Square	0.359
Adj R-Sq	0.315
Dependent Mean	3.255
Coeff Var	39.933

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.539	0.597	7.610	<.0001
Q3	0.056	0.067	0.850	0.399
OWNALL	-0.367	0.217	-1.690	0.092
CROPS	0.034	0.268	0.130	0.900
DAIRYFM	-0.086	0.410	-0.210	0.833
LIVESTK	-1.033	0.461	-2.240	0.026
ORCHARD	0.329	0.243	1.360	0.176
FLDFRRW	-1.123	0.237	-4.740	<.0001
SPRNKLR	-0.377	0.259	-1.450	0.148
FAMOWN	0.223	0.239	0.930	0.352
Q43AGE	0.000	0.007	0.050	0.960
Q9	-1.159	0.236	-4.910	<.0001
Q11	0.060	0.045	1.320	0.189
OVERTEN	-0.078	0.280	-0.280	0.780
Q41	0.005	0.003	1.760	0.080

Hypothesis 2b

The LOGISTIC Procedure

Response Variable	Q30AA

<q30aa> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	218.000

Probability Modeled Is Q30AA='1'.

R-Square	0.151	**Max-rescaled R-Square**	0.218

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	35.558	14.000	0.001
Score	34.774	14.000	0.002
Wald	28.615	14.000	0.012

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	1.991	1.061	3.524	0.061
Q4	-0.011	0.127	0.007	0.935
OWNALL	0.282	0.418	0.455	0.500
CROPS	-0.075	0.508	0.022	0.883
DAIRYFM	-0.826	0.698	1.398	0.237
LIVESTK	-1.145	0.822	1.943	0.163
ORCHARD	0.491	0.488	1.011	0.315
FLDFRRW	-1.058	0.451	5.503	0.019
SPRNKLR	-0.397	0.513	0.600	0.439
FAMOWN	0.326	0.459	0.505	0.477
Q43AGE	-0.004	0.014	0.078	0.780
Q9	-0.660	0.405	2.650	0.104
Q11	0.153	0.085	3.260	0.071
OVERTEN	-0.898	0.619	2.103	0.147
Q41	0.008	0.010	0.646	0.422

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q4	0.990	0.771	1.270
OWNALL	1.325	0.584	3.005
CROPS	0.928	0.343	2.511
DAIRYFM	0.438	0.111	1.721
LIVESTK	0.318	0.064	1.592
ORCHARD	1.633	0.628	4.248
FLDFRRW	0.347	0.144	0.840
SPRNKLR	0.672	0.246	1.838
FAMOWN	1.386	0.563	3.409
Q43AGE	0.996	0.970	1.023
Q9	0.517	0.234	1.144
Q11	1.166	0.987	1.377
OVERTEN	0.407	0.121	1.371
Q41	1.008	0.989	1.028

Hypothesis 2b

The LOGISTIC Procedure

Response Variable	Q30BA

<q30ba> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	217.000

Probability Modeled Is Q30BA='1'.

R-Square	0.180	**Max-rescaled R-Square**	0.240

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	43.059	14.000	<.0001
Score	38.377	14.000	0.001
Wald	30.344	14.000	0.007

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	0.840	0.930	0.816	0.366
Q4	0.190	0.108	3.085	0.079
OWNALL	0.074	0.387	0.037	0.848
CROPS	0.052	0.464	0.013	0.911
DAIRYFM	-0.163	0.711	0.053	0.818
LIVESTK	-2.122	1.155	3.375	0.066
ORCHARD	0.532	0.416	1.633	0.201
FLDFRRW	-0.764	0.408	3.503	0.061
SPRNKLR	-0.322	0.440	0.536	0.464
FAMOWN	-0.112	0.410	0.075	0.784
Q43AGE	0.002	0.013	0.022	0.883
Q9	-1.218	0.428	8.106	0.004
Q11	0.111	0.077	2.103	0.147
OVERTEN	-0.993	0.509	3.810	0.051
Q41	0.013	0.009	2.091	0.148

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q4	1.209	0.978	1.495
OWNALL	1.077	0.505	2.299
CROPS	1.053	0.424	2.616
DAIRYFM	0.849	0.211	3.419
LIVESTK	0.120	0.012	1.153
ORCHARD	1.702	0.753	3.849
FLDFRRW	0.466	0.209	1.037
SPRNKLR	0.725	0.306	1.716
FAMOWN	0.894	0.400	1.995
Q43AGE	1.002	0.977	1.027
Q9	0.296	0.128	0.684
Q11	1.117	0.962	1.299
OVERTEN	0.371	0.137	1.004
Q41	1.013	0.995	1.031

Hypothesis 2b

The LOGISTIC Procedure

Response Variable	Q30CA

<q30ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	158.000

Probability Modeled Is Q30CA='1'.

R-Square	0.091	**Max-rescaled R-Square**	0.258

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	15.107	9.000	0.088
Score	15.425	9.000	0.080
Wald	11.606	9.000	0.236

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	5.891	2.683	4.822	0.028
Q4	-0.511	0.354	2.090	0.148
OWNALL	-1.216	1.068	1.296	0.255
CROPS	-2.155	0.926	5.414	0.020
FLDFRRW	-1.867	0.805	5.380	0.020
FAMOWN	1.127	1.005	1.259	0.262
Q43AGE	0.009	0.038	0.060	0.807
Q11	0.065	0.208	0.096	0.757
OVERTEN	0.548	1.245	0.194	0.660
Q41	0.026	0.032	0.704	0.402

Odds Ratio Estimates

Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Q4	0.600	0.300	1.199
OWNALL	0.296	0.037	2.405
CROPS	0.116	0.019	0.712
FLDFRRW	0.155	0.032	0.749
FAMOWN	3.087	0.431	22.109
Q43AGE	1.009	0.937	1.087
Q11	1.067	0.709	1.604
OVERTEN	1.729	0.151	19.824
Q41	1.027	0.965	1.092

Hypothesis 2b

The LOGISTIC Procedure

Response Variable	Q30DA

<q30da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	101.000

Probability Modeled Is Q30DA='1'.

R-Square	0.099	**Max-rescaled R-Square**	0.132

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	10.538	11.000	0.483
Score	10.066	11.000	0.525
Wald	9.173	11.000	0.606

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-0.013	1.423	0.000	0.993
Q4	-0.150	0.165	0.827	0.363
OWNALL	-0.392	0.509	0.593	0.441
CROPS	0.771	0.540	2.036	0.154
FLDFRRW	-0.409	0.635	0.415	0.519
SPRNKLR	0.382	0.512	0.558	0.455
FAMOWN	0.313	0.562	0.311	0.577
Q43AGE	-0.009	0.019	0.201	0.654
Q9	-0.570	0.602	0.899	0.343
Q11	0.093	0.114	0.665	0.415
OVERTEN	1.177	0.713	2.728	0.099
Q41	-0.007	0.009	0.495	0.482

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q4	0.861	0.623	1.189
OWNALL	0.676	0.249	1.832
CROPS	2.162	0.750	6.232
FLDFRRW	0.664	0.191	2.306
SPRNKLR	1.466	0.537	3.998
FAMOWN	1.368	0.455	4.111
Q43AGE	0.991	0.955	1.029
Q9	0.565	0.174	1.838
Q11	1.098	0.877	1.373
OVERTEN	3.246	0.803	13.127
Q41	0.993	0.976	1.012

Hypothesis 2b

The LOGISTIC Procedure

Response Variable	Q30EA

<q30ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	166.000

Probability Modeled Is Q30EA='1'.

R-Square	0.164	**Max-rescaled R-Square**	0.448

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	29.668	11.000	0.002
Score	39.636	11.000	<.0001
Wald	16.483	11.000	0.124

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	4.996	2.270	4.843	0.028
Q4	0.165	0.262	0.397	0.529
OWNALL	-1.382	1.040	1.767	0.184
CROPS	-2.643	0.980	7.275	0.007
FLDFRRW	-1.406	1.101	1.631	0.202
SPRNKLR	-0.001	1.139	0.000	0.999
FAMOWN	-0.341	1.451	0.055	0.815
Q43AGE	0.018	0.044	0.170	0.680
Q9	-2.874	0.967	8.831	0.003
Q11	0.311	0.226	1.898	0.168
OVERTEN	1.708	1.111	2.363	0.124
Q41	0.012	0.032	0.148	0.701

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q4	1.179	0.706	1.971
OWNALL	0.251	0.033	1.926
CROPS	0.071	0.010	0.486
FLDFRRW	0.245	0.028	2.121
SPRNKLR	0.999	0.107	9.308
FAMOWN	0.711	0.041	12.233
Q43AGE	1.018	0.934	1.110
Q9	0.056	0.008	0.376
Q11	1.364	0.877	2.122
OVERTEN	5.519	0.625	48.741
Q41	1.012	0.951	1.078

Hypothesis 2b

The LOGISTIC Procedure

Response Variable	Q30FA

<q30fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	141.000

Probability Modeled Is Q30FA='1'.

R-Square	0.131	**Max-rescaled R-Square**	0.174

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	19.738	14.000	0.139
Score	18.654	14.000	0.179
Wald	16.720	14.000	0.271

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-0.293	1.262	0.054	0.817
Q4	0.086	0.160	0.288	0.592
OWNALL	-0.020	0.456	0.002	0.965
CROPS	1.421	0.560	6.446	0.011
DAIRYFM	2.329	0.836	7.769	0.005
LIVESTK	1.424	0.886	2.586	0.108
ORCHARD	0.891	0.515	2.990	0.084
FLDFRRW	0.111	0.456	0.059	0.807
SPRNKLR	-0.230	0.599	0.147	0.701
FAMOWN	0.465	0.524	0.789	0.374
Q43AGE	-0.002	0.016	0.020	0.887
Q9	-0.741	0.467	2.517	0.113
Q11	-0.103	0.092	1.244	0.265
OVERTEN	-0.234	0.644	0.132	0.717
Q41	0.006	0.012	0.212	0.646

Odds Ratio Estimates

Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Q4	1.089	0.797	1.489
OWNALL	0.980	0.401	2.395
CROPS	4.140	1.383	12.394
DAIRYFM	10.266	1.996	52.794
LIVESTK	4.154	0.732	23.564
ORCHARD	2.437	0.888	6.688
FLDFRRW	1.118	0.457	2.731
SPRNKLR	0.795	0.246	2.571
FAMOWN	1.593	0.570	4.447
Q43AGE	0.998	0.967	1.029
Q9	0.477	0.191	1.190
Q11	0.902	0.753	1.081
OVERTEN	0.792	0.224	2.797
Q41	1.006	0.982	1.030

Hypothesis 2b

The LOGISTIC Procedure

Response Variable	Q30GA

<q30ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	220.000

Probability Modeled Is Q30GA='1'.

R-Square	0.081	**Max-rescaled R-Square**	0.156

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	18.519	14.000	0.184
Score	17.107	14.000	0.251
Wald	14.525	14.000	0.411

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-3.347	1.747	3.671	0.055
Q4	0.004	0.172	0.001	0.981
OWNALL	-0.471	0.509	0.856	0.355
CROPS	0.801	0.671	1.427	0.232
DAIRYFM	-0.544	1.214	0.201	0.654
LIVESTK	0.170	1.252	0.019	0.892
ORCHARD	0.662	0.635	1.085	0.298
FLDFRRW	0.628	0.552	1.294	0.255
SPRNKLR	-1.287	0.854	2.270	0.132
FAMOWN	1.634	1.053	2.408	0.121
Q43AGE	-0.021	0.021	0.999	0.318
Q9	-0.318	0.599	0.282	0.595
Q11	-0.037	0.107	0.121	0.728
OVERTEN	0.470	0.814	0.333	0.564
Q41	0.008	0.005	2.063	0.151

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q4	1.004	0.717	1.407
OWNALL	0.624	0.230	1.694
CROPS	2.228	0.599	8.290
DAIRYFM	0.580	0.054	6.267
LIVESTK	1.186	0.102	13.796
ORCHARD	1.938	0.558	6.731
FLDFRRW	1.874	0.635	5.529
SPRNKLR	0.276	0.052	1.473
FAMOWN	5.124	0.651	40.364
Q43AGE	0.979	0.939	1.021
Q9	0.727	0.225	2.353
Q11	0.963	0.781	1.189
OVERTEN	1.600	0.324	7.893
Q41	1.008	0.997	1.018

Hypothesis 2b

The REG Procedure

Dependent Variable: TTLBEHV <ttlbehv> Variable indicating the total number of behavioral changes that were implemented, with the maximum number possible being 7

Number of Observations Read	249.000
Number of Observations Used	223.000

R-Square	0.354
Adj R-Sq	0.314
Dependent Mean	3.242
Coeff Var	40.103

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.807	0.509	9.450	<.0001
OWNALL	-0.348	0.214	-1.630	0.105
CROPS	0.011	0.267	0.040	0.966
DAIRYFM	-0.039	0.409	-0.100	0.924
LIVESTK	-1.041	0.460	-2.260	0.025
ORCHARD	0.352	0.241	1.460	0.146
FLDFRRW	-1.163	0.234	-4.980	<.0001
SPRNKLR	-0.353	0.257	-1.370	0.172
FAMOWN	0.220	0.238	0.920	0.358
Q43AGE	0.001	0.007	0.130	0.894
Q9	-1.114	0.234	-4.760	<.0001
Q11	0.058	0.045	1.290	0.198
OVERTEN	-0.089	0.279	-0.320	0.749
Q41	0.006	0.003	1.850	0.065

Hypothesis 4

The LOGISTIC Procedure

Response Variable	Q30AA

<q30aa> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	216.000

Probability Modeled Is Q30AA='1'.

R-Square	0.160	**Max-rescaled R-Square**	0.231

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	37.628	17.000	0.003
Score	35.947	17.000	0.005
Wald	29.697	17.000	0.029

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	1.363	1.225	1.238	0.266
PWRKGFM4	0.009	0.004	4.233	0.040
aware	0.043	0.154	0.079	0.779
OWNALL	0.274	0.433	0.398	0.528
LARGE	0.104	0.579	0.032	0.858
MEDIUM	0.063	0.407	0.024	0.877
CROPS	-0.197	0.526	0.141	0.707
DAIRYFM	-1.089	0.769	2.006	0.157
LIVESTK	-1.219	0.836	2.128	0.145
ORCHARD	0.420	0.499	0.709	0.400
FLDFRRW	-0.850	0.467	3.309	0.069
SPRNKLR	-0.306	0.530	0.334	0.563
FAMOWN	0.523	0.493	1.125	0.289
Q43AGE	-0.004	0.014	0.087	0.768
Q9	-0.543	0.419	1.681	0.195
Q11	0.095	0.086	1.212	0.271
OVERTEN	-1.039	0.633	2.689	0.101
Q41	0.002	0.009	0.031	0.860

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	1.009	1.000	1.017
aware	1.044	0.772	1.412
OWNALL	1.315	0.562	3.073
LARGE	1.109	0.357	3.450
MEDIUM	1.065	0.480	2.364
CROPS	0.821	0.293	2.300
DAIRYFM	0.337	0.075	1.519
LIVESTK	0.295	0.057	1.520
ORCHARD	1.522	0.572	4.048
FLDFRRW	0.427	0.171	1.068
SPRNKLR	0.736	0.261	2.080
FAMOWN	1.686	0.642	4.428
Q43AGE	0.996	0.970	1.023
Q9	0.581	0.255	1.320
Q11	1.100	0.928	1.303
OVERTEN	0.354	0.102	1.225
Q41	1.002	0.985	1.018

Hypothesis 4

The LOGISTIC Procedure

Response Variable	Q30BA

<q30ba> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	215.000

Probability Modeled Is Q30BA='1'.

R-Square	0.173	**Max-rescaled R-Square**	0.231

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	40.944	17.000	0.001
Score	36.788	17.000	0.004
Wald	29.389	17.000	0.031

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	0.585	1.079	0.294	0.588
PWRKGFM4	0.003	0.004	0.827	0.363
aware	0.168	0.134	1.578	0.209
OWNALL	0.148	0.394	0.142	0.707
LARGE	-0.054	0.509	0.011	0.916
MEDIUM	0.042	0.367	0.013	0.910
CROPS	-0.071	0.474	0.022	0.882
DAIRYFM	-0.360	0.756	0.227	0.634
LIVESTK	-2.107	1.155	3.328	0.068
ORCHARD	0.407	0.426	0.911	0.340
FLDFRRW	-0.620	0.428	2.097	0.148
SPRNKLR	-0.302	0.451	0.449	0.503
FAMOWN	-0.052	0.428	0.015	0.903
Q43AGE	0.004	0.013	0.081	0.777
Q9	-1.081	0.437	6.124	0.013
Q11	0.092	0.079	1.347	0.246
OVERTEN	-0.931	0.512	3.304	0.069
Q41	0.012	0.010	1.405	0.236

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	1.003	0.996	1.011
aware	1.183	0.910	1.536
OWNALL	1.160	0.536	2.509
LARGE	0.948	0.350	2.569
MEDIUM	1.042	0.508	2.138
CROPS	0.932	0.368	2.360
DAIRYFM	0.698	0.159	3.068
LIVESTK	0.122	0.013	1.170
ORCHARD	1.502	0.651	3.463
FLDFRRW	0.538	0.232	1.245
SPRNKLR	0.739	0.305	1.789
FAMOWN	0.949	0.410	2.196
Q43AGE	1.004	0.978	1.030
Q9	0.339	0.144	0.799
Q11	1.096	0.939	1.280
OVERTEN	0.394	0.145	1.076
Q41	1.012	0.992	1.032

Hypothesis 4

The LOGISTIC Procedure

Response Variable	Q30CA

<q30ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	156.000

Probability modeled is Q30CA='1'

R-Square	0.126	**Max-rescaled R-Square**	0.352

Testing Global Null Hypothesis: BETA=0

Test	**Chi-Square**	**DF**	**Pr > Chi Sq**
Likelihood Ratio	20.958	11.000	0.034
Score	30.373	11.000	0.001
Wald	16.097	11.000	0.138

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
ntercept	8.097	3.067	6.969	0.008
PWRKGFM4	0.011	0.010	1.202	0.273
aware	-0.112	0.370	0.092	0.762
OWNALL	-1.172	1.121	1.094	0.296
LARGE	-1.373	1.582	0.753	0.386
MEDIUM	-0.664	1.078	0.379	0.538
CROPS	-1.189	1.049	1.285	0.257
FLDFRRW	-1.344	0.863	2.425	0.119
Q43AGE	0.020	0.043	0.220	0.639
Q9	-2.548	0.951	7.188	0.007
Q11	-0.045	0.217	0.042	0.837
Q41	0.015	0.040	0.143	0.705

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	1.011	0.992	1.031
aware	0.894	0.433	1.847
OWNALL	0.310	0.034	2.786
LARGE	0.253	0.011	5.625
MEDIUM	0.515	0.062	4.256
CROPS	0.305	0.039	2.378
FLDFRRW	0.261	0.048	1.416
Q43AGE	1.021	0.937	1.111
Q9	0.078	0.012	0.504
Q11	0.956	0.625	1.464
Q41	1.015	0.938	1.099

Hypothesis 4

The LOGISTIC Procedure

Response Variable	Q30DA

<q30da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	98.000

Probability Modeled Is Q30DA='1'.

R-Square	0.126	**Max-rescaled R-Square**	0.168

Testing Global Null Hypothesis: BETA=0

Test	**Chi-Square**	**DF**	**Pr > Chi Sq**
Likelihood Ratio	13.192	14.000	0.512
Score	12.406	14.000	0.574
Wald	10.962	14.000	0.689

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-0.541	1.766	0.094	0.759
PWRKGFM4	0.004	0.006	0.427	0.513
aware	-0.034	0.202	0.029	0.866
OWNALL	-0.258	0.565	0.209	0.648
LARGE	0.553	0.767	0.521	0.471
MEDIUM	-0.146	0.581	0.063	0.802
CROPS	0.810	0.562	2.078	0.149
FLDFRRW	-0.404	0.701	0.332	0.564
SPRNKLR	0.481	0.558	0.745	0.388
FAMOWN	0.335	0.602	0.309	0.578
Q43AGE	-0.006	0.020	0.088	0.767
Q9	-1.022	0.687	2.212	0.137
Q11	0.077	0.118	0.420	0.517
OVERTEN	1.260	0.736	2.936	0.087
Q41	-0.014	0.013	1.170	0.280

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	1.004	0.992	1.015
aware	0.966	0.651	1.436
OWNALL	0.772	0.255	2.337
LARGE	1.738	0.387	7.810
MEDIUM	0.864	0.276	2.700
CROPS	2.248	0.747	6.765
FLDFRRW	0.668	0.169	2.637
SPRNKLR	1.618	0.542	4.828
FAMOWN	1.398	0.429	4.548
Q43AGE	0.994	0.955	1.034
Q9	0.360	0.094	1.384
Q11	1.080	0.856	1.362
OVERTEN	3.527	0.834	14.913
Q41	0.986	0.962	1.011

Hypothesis 4

The LOGISTIC Procedure

Response Variable	Q30EA

<q30ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	164.000

Probability Modeled Is Q30EA='1'.

R-Square	0.220	**Max-rescaled R-Square**	0.596

Testing Global Null Hypothesis: BETA=0

Test	**Chi-Square**	**DF**	**Pr > Chi Sq**
Likelihood Ratio	40.673	14.000	0.000
Score	43.823	14.000	<.0001
Wald	12.199	14.000	0.590

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	7.152	3.695	3.746	0.053
PWRKGFM4	0.033	0.018	3.626	0.057
aware	0.258	0.541	0.228	0.633
OWNALL	-1.148	1.510	0.578	0.447
LARGE	-6.238	2.829	4.862	0.028
MEDIUM	-0.402	1.628	0.061	0.805
CROPS	-4.295	1.829	5.512	0.019
FLDFRRW	-2.278	1.686	1.826	0.177
SPRNKLR	0.372	1.419	0.069	0.793
FAMOWN	-2.527	2.124	1.414	0.234
Q43AGE	0.030	0.058	0.266	0.606
Q9	-4.154	1.460	8.091	0.004
Q11	0.442	0.310	2.035	0.154
OVERTEN	2.309	1.398	2.728	0.099
Q41	0.121	0.071	2.923	0.087

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	1.034	0.999	1.070
aware	1.294	0.449	3.734
OWNALL	0.317	0.016	6.119
LARGE	0.002	<0.001	0.500
MEDIUM	0.669	0.027	16.274
CROPS	0.014	<0.001	0.492
FLDFRRW	0.103	0.004	2.790
SPRNKLR	1.451	0.090	23.395
FAMOWN	0.080	0.001	5.141
Q43AGE	1.030	0.920	1.153
Q9	0.016	<0.001	0.275
Q11	1.556	0.848	2.858
OVERTEN	10.062	0.650	155.815
Q41	1.128	0.982	1.296

Hypothesis 4

The LOGISTIC Procedure

Response Variable	Q30FA

<q30fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	139.000

Probability Modeled Is Q30FA='1'.

R-Square	0.219	**Max-rescaled R-Square**	0.292

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	34.285	17.000	0.008
Score	30.537	17.000	0.023
Wald	24.917	17.000	0.097

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-1.881	1.660	1.283	0.257
PWRKGFM4	-0.003	0.005	0.350	0.554
aware	0.482	0.226	4.567	0.033
OWNALL	-0.064	0.505	0.016	0.899
LARGE	-1.452	0.773	3.527	0.060
MEDIUM	0.132	0.509	0.067	0.796
CROPS	2.057	0.647	10.108	0.002
DAIRYFM	3.684	1.071	11.837	0.001
LIVESTK	2.344	0.987	5.635	0.018
ORCHARD	1.355	0.585	5.370	0.021
FLDFRRW	-0.251	0.544	0.213	0.645
SPRNKLR	-0.631	0.678	0.867	0.352
FAMOWN	0.263	0.588	0.201	0.654
Q43AGE	-0.016	0.017	0.895	0.344
Q9	-0.878	0.512	2.939	0.087
Q11	-0.128	0.102	1.566	0.211
OVERTEN	-0.410	0.709	0.335	0.563
Q41	0.023	0.017	1.780	0.182
OVERTEN	-0.410	0.709	0.335	0.563
Q41	0.023	0.017	1.780	0.182

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	0.997	0.987	1.007
aware	1.619	1.041	2.519
OWNALL	0.938	0.349	2.522
LARGE	0.234	0.051	1.065
MEDIUM	1.141	0.421	3.093
CROPS	7.820	2.201	27.786
DAIRYFM	39.807	4.881	324.666
LIVESTK	10.420	1.505	72.159
ORCHARD	3.875	1.232	12.183
FLDFRRW	0.778	0.268	2.258
SPRNKLR	0.532	0.141	2.008
FAMOWN	1.301	0.411	4.116
Q43AGE	0.984	0.952	1.017
Q9	0.415	0.152	1.134
Q11	0.880	0.720	1.075
OVERTEN	0.664	0.166	2.661
Q41	1.023	0.989	1.059

Hypothesis 4

The LOGISTIC Procedure

Response Variable	Q30GA

<q30ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	218.000

Probability Modeled Is Q30GA='1'.

R-Square	0.092	**Max-rescaled R-Square**	0.177

Testing Global Null Hypothesis: BETA=0

Test	**Chi-Square**	**DF**	**Pr > Chi Sq**
Likelihood Ratio	20.951	17.000	0.229
Score	19.436	17.000	0.304
Wald	16.141	17.000	0.514

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-4.022	2.040	3.887	0.049
PWRKGFM4	-0.006	0.006	0.982	0.322
aware	0.130	0.222	0.341	0.559
OWNALL	-0.539	0.529	1.040	0.308
LARGE	-0.372	0.837	0.197	0.657
MEDIUM	0.401	0.544	0.545	0.461
CROPS	1.030	0.709	2.110	0.146
DAIRYFM	-0.080	1.282	0.004	0.951
LIVESTK	0.318	1.280	0.062	0.804
ORCHARD	0.765	0.662	1.335	0.248
FLDFRRW	0.526	0.584	0.811	0.368
SPRNKLR	-1.320	0.880	2.250	0.134
FAMOWN	1.429	1.068	1.793	0.181
Q43AGE	-0.024	0.022	1.267	0.260
Q9	-0.324	0.617	0.275	0.600
Q11	0.007	0.116	0.003	0.954
OVERTEN	0.469	0.830	0.319	0.572
Q41	0.012	0.007	3.558	0.059

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	0.994	0.983	1.006
aware	1.138	0.737	1.759
OWNALL	0.583	0.207	1.644
LARGE	0.689	0.134	3.558
MEDIUM	1.494	0.515	4.337
CROPS	2.801	0.698	11.245
DAIRYFM	0.923	0.075	11.395
LIVESTK	1.375	0.112	16.902
ORCHARD	2.149	0.587	7.870
FLDFRRW	1.691	0.539	5.311
SPRNKLR	0.267	0.048	1.499
FAMOWN	4.176	0.515	33.844
Q43AGE	0.976	0.935	1.018
Q9	0.724	0.216	2.425
Q11	1.007	0.802	1.264
OVERTEN	1.598	0.314	8.123
Q41	1.012	1.000	1.025

Hypothesis 4

The LOGISTIC Procedure

Response Variable	Q30HA

<q30ha> Did you regularly adjust bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	4.000

Probability Modeled Is Q30HA='2'.

R-Square	0.675	**Max-rescaled R-Square**	1.000

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	4.498	3.000	0.213
Score	4.000	3.000	0.262
Wald	0.014	3.000	1.000

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	9.566	119.500	0.006	0.936
PWRKGFM4	-0.196	1.897	0.011	0.918
aware	0.000	0.000	.	.
OWNALL	0.000	0.000	.	.
LARGE	0.000	0.000	.	.
MEDIUM	19.552	189.700	0.011	0.918
CROPS	0.000	169.000	0.000	1.000
DAIRYFM	0.000	0.000	.	.
LIVESTK	0.000	0.000	.	.
ORCHARD	0.000	0.000	.	.
FLDFRRW	0.000	0.000	.	.
SPRNKLR	0.000	0.000	.	.
FAMOWN	0.000	0.000	.	.
Q43AGE	0.000	0.000	.	.
Q9	0.000	0.000	.	.
Q11	0.000	0.000	.	.
OVERTEN	0.000	0.000	.	.
Q41	0.000	0.000	.	.

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	0.822	0.020	33.896
MEDIUM	>999.999	<0.001	>999.999
CROPS	1.000	<0.001	>999.999

Hypothesis 4

The REG Procedure

Dependent Variable: TTLBEHV <ttlbehv> Variable indicating the total number of behavioral changes that were implemented, with the maximum number possible being 7

Number of Observations Read	249.000
Number of Observations Used	219.000

R-Square	0.382
Adj R-Sq	0.330
Dependent Mean	3.242
Coeff Var	39.677

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.322	0.635	6.810	<.0001
PWRKGFM4	0.004	0.002	1.750	0.081
aware	0.056	0.078	0.720	0.469
OWNALL	-0.295	0.221	-1.330	0.184
LARGE	0.158	0.287	0.550	0.584
MEDIUM	0.152	0.212	0.720	0.474
CROPS	0.007	0.273	0.030	0.979
DAIRYFM	-0.336	0.438	-0.770	0.443
LIVESTK	-1.079	0.462	-2.340	0.020
ORCHARD	0.263	0.248	1.060	0.290
FLDFRRW	-1.017	0.244	-4.160	<.0001
SPRNKLR	-0.277	0.262	-1.060	0.291
FAMOWN	0.347	0.251	1.380	0.168
Q43AGE	-0.001	0.007	-0.150	0.879
Q9	-1.147	0.244	-4.710	<.0001
Q11	0.029	0.046	0.620	0.537
OVERTEN	-0.152	0.281	-0.540	0.589
Q41	0.003	0.003	0.980	0.331

Hypothesis 5

The LOGISTIC Procedure

Response Variable	Q13

<q13> Do you have a flow meter installed on any of the pumps in your farming operation?

Number of Observations Read	249.000
Number of Observations Used	220.000

Probability Modeled Is Q13='1'.

R-Square	0.421	**Max-rescaled R-Square**	0.561

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	120.044	18.000	<.0001
Score	83.504	18.000	<.0001
Wald	52.892	18.000	<.0001

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	2.106	1.556	1.832	0.176
Q11	0.367	0.103	12.616	0.000
OWNALL	-0.600	0.481	1.554	0.213
LARGE	0.435	0.676	0.414	0.520
MEDIUM	-0.114	0.460	0.061	0.805
CROPS	0.966	0.860	1.260	0.262
DAIRYFM	2.505	1.120	5.000	0.025
LIVESTK	0.836	1.187	0.496	0.481
ORCHARD	1.244	0.819	2.305	0.129
VNYDWNY	0.089	0.876	0.010	0.919
FLDFRRW	-2.088	0.566	13.583	0.000
SPRNKLR	-0.853	0.586	2.119	0.146
FAMOWN	-0.805	0.550	2.146	0.143
Q43AGE	-0.020	0.017	1.393	0.238
Q4	-0.156	0.132	1.409	0.235
Q7	-1.867	0.450	17.188	<.0001
Q9	-0.350	0.559	0.391	0.532
OVERTEN	0.533	0.633	0.708	0.400
Q41	0.105	0.027	14.828	0.000

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q11	1.443	1.179	1.767
OWNALL	0.549	0.214	1.410
LARGE	1.545	0.411	5.812
MEDIUM	0.893	0.362	2.200
CROPS	2.627	0.487	14.182
DAIRYFM	12.243	1.363	110.012
LIVESTK	2.307	0.225	23.620
ORCHARD	3.469	0.696	17.282
VNYDWNY	1.093	0.196	6.081
FLDFRRW	0.124	0.041	0.376
SPRNKLR	0.426	0.135	1.344
FAMOWN	0.447	0.152	1.313
Q43AGE	0.980	0.948	1.013
Q4	0.855	0.661	1.107
Q7	0.155	0.064	0.374
Q9	0.705	0.236	2.110
OVERTEN	1.704	0.493	5.891
Q41	1.110	1.053	1.171

Hypothesis 5

The REG Procedure

Dependent Variable: PWRKGFM4

Number of Observations Read	249.000
Number of Observations Used	218.000

R-Square	0.385
Adj R-Sq	0.329
Dependent Mean	50.083
Coeff Var	81.060

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	81.831	23.155	3.530	0.001
Q11	5.796	1.402	4.130	<.0001
OWNALL	-13.201	6.973	-1.890	0.060
LARGE	23.386	9.023	2.590	0.010
MEDIUM	7.991	6.712	1.190	0.235
CROPS	17.485	11.977	1.460	0.146
DAIRYFM	34.123	15.823	2.160	0.032
LIVESTK	11.872	16.783	0.710	0.480
ORCHARD	20.569	11.521	1.790	0.076
VNYDWNY	-0.084	12.205	-0.010	0.995
FLDFRRW	-30.238	7.667	-3.940	0.000
SPRNKLR	-11.045	8.491	-1.300	0.195
FAMOWN	-12.610	7.881	-1.600	0.111
Q43AGE	-0.224	0.235	-0.950	0.342
Q4	-1.502	2.061	-0.730	0.467
Q7	-25.558	6.210	-4.120	<.0001
Q9	-6.655	7.868	-0.850	0.399
OVERTEN	5.267	8.892	0.590	0.554
Q41	0.278	0.103	2.700	0.008

Hypotheses 6&13

The LOGISTIC Procedure

Response Variable	Q30AA

<q30aa> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	111.000

Probability Modeled Is Q30AA='1'.

R-Square	0.146	**Max-rescaled R-Square**	0.239

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	17.521	17.000	0.420
Score	15.345	17.000	0.571
Wald	12.368	17.000	0.777

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	4.088	2.615	2.444	0.118
Q27	0.139	0.239	0.336	0.562
Q28	0.052	0.252	0.042	0.837
Q3	-0.432	0.336	1.649	0.199
Q4	0.054	0.260	0.043	0.836
OWNALL	0.210	0.694	0.092	0.762
CROPS	-1.675	1.090	2.361	0.124
DAIRYFM	-1.918	1.251	2.349	0.125
LIVESTK	-1.677	1.686	0.989	0.320
ORCHARD	-1.219	1.055	1.335	0.248
FLDFRRW	-1.593	0.825	3.723	0.054
SPRNKLR	-0.420	0.780	0.290	0.590
FAMOWN	0.719	0.663	1.174	0.279
Q43AGE	-0.020	0.030	0.433	0.511
Q9	0.604	0.868	0.485	0.486
Q11	0.100	0.185	0.291	0.590
OVERTEN	-0.952	1.216	0.614	0.433
Q41	-0.001	0.010	0.006	0.939

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	1.149	0.719	1.837
Q28	1.053	0.642	1.727
Q3	0.649	0.336	1.255
Q4	1.055	0.634	1.756
OWNALL	1.234	0.317	4.812
CROPS	0.187	0.022	1.586
DAIRYFM	0.147	0.013	1.707
LIVESTK	0.187	0.007	5.094
ORCHARD	0.296	0.037	2.336
FLDFRRW	0.203	0.040	1.025
SPRNKLR	0.657	0.142	3.030
FAMOWN	2.052	0.559	7.528
Q43AGE	0.980	0.924	1.040
Q9	1.830	0.334	10.026
Q11	1.105	0.769	1.586
OVERTEN	0.386	0.036	4.178
Q41	0.999	0.980	1.019

Hypotheses 6&13

The LOGISTIC Procedure

Response Variable	Q30BA

<q30ba> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	110.000

Probability Modeled Is Q30BA='1'.

R-Square	0.143	**Max-rescaled R-Square**	0.195

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	16.989	17.000	0.455
Score	15.603	17.000	0.552
Wald	12.924	17.000	0.741

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	1.274	1.759	0.525	0.469
Q27	0.092	0.192	0.230	0.632
Q28	-0.244	0.204	1.435	0.231
Q3	0.033	0.194	0.028	0.867
Q4	0.029	0.186	0.024	0.876
OWNALL	-0.306	0.553	0.306	0.581
CROPS	0.464	0.686	0.457	0.499
DAIRYFM	-0.044	0.993	0.002	0.965
LIVESTK	-0.430	1.481	0.084	0.772
ORCHARD	0.744	0.653	1.296	0.255
FLDFRRW	-0.726	0.699	1.079	0.299
SPRNKLR	-0.215	0.618	0.120	0.729
FAMOWN	0.548	0.525	1.091	0.296
Q43AGE	-0.036	0.023	2.491	0.115
Q9	-0.760	0.707	1.156	0.282
Q11	0.131	0.143	0.839	0.360
OVERTEN	-0.138	0.732	0.036	0.850
Q41	0.015	0.012	1.632	0.202

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	1.096	0.752	1.598
Q28	0.784	0.526	1.168
Q3	1.033	0.706	1.511
Q4	1.029	0.715	1.482
OWNALL	0.737	0.249	2.178
CROPS	1.590	0.415	6.095
DAIRYFM	0.957	0.137	6.702
LIVESTK	0.651	0.036	11.856
ORCHARD	2.103	0.585	7.565
FLDFRRW	0.484	0.123	1.905
SPRNKLR	0.807	0.240	2.710
FAMOWN	1.730	0.618	4.843
Q43AGE	0.965	0.922	1.009
Q9	0.468	0.117	1.869
Q11	1.140	0.861	1.509
OVERTEN	0.871	0.207	3.659
Q41	1.015	0.992	1.039

Hypotheses 6&13

The LOGISTIC Procedure

Response Variable	Q30CA

<q30ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	98.000

Probability Modeled Is Q30CA='1'.

R-Square	0.042	**Max-rescaled R-Square**	0.146

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	4.211	5.000	0.520
Score	5.278	5.000	0.383
Wald	4.133	5.000	0.531

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	2.364	3.086	0.587	0.444
Q27	-0.235	0.543	0.187	0.666
Q28	0.622	0.575	1.169	0.280
Q3	0.380	0.335	1.284	0.257
Q4	-0.511	0.488	1.099	0.295
OWNALL	-0.558	1.274	0.192	0.661

Odds Ratio Estimates

Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Q27	0.791	0.273	2.294
Q28	1.863	0.603	5.755
Q3	1.462	0.758	2.818
Q4	0.600	0.231	1.560
OWNALL	0.572	0.047	6.953

Hypotheses 6&13

The LOGISTIC Procedure

Response Variable	Q30DA

<q30da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	62.000

Probability Modeled Is Q30DA='1'.

R-Square	0.340	**Max-rescaled R-Square**	0.453

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	25.740	14.000	0.028
Score	20.424	14.000	0.117
Wald	12.950	14.000	0.531

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-9.441	3.424	7.602	0.006
Q27	0.843	0.378	4.970	0.026
Q28	0.432	0.332	1.691	0.194
Q3	-0.457	0.351	1.698	0.193
Q4	0.188	0.294	0.409	0.523
OWNALL	0.339	0.770	0.194	0.660
CROPS	1.493	0.921	2.629	0.105
FLDFRRW	-1.978	1.115	3.146	0.076
SPRNKLR	0.132	0.882	0.022	0.881
FAMOWN	-0.432	0.891	0.235	0.628
Q43AGE	0.029	0.037	0.601	0.438
Q9	2.185	1.387	2.482	0.115
Q11	0.018	0.208	0.007	0.933
OVERTEN	1.569	0.982	2.554	0.110
Q41	-0.017	0.017	1.012	0.314

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	2.322	1.107	4.871
Q28	1.540	0.803	2.952
Q3	0.633	0.318	1.259
Q4	1.207	0.678	2.148
OWNALL	1.403	0.310	6.341
CROPS	4.451	0.732	27.053
FLDFRRW	0.138	0.016	1.231
SPRNKLR	1.141	0.203	6.429
FAMOWN	0.649	0.113	3.724
Q43AGE	1.029	0.957	1.107
Q9	8.892	0.587	134.806
Q11	1.018	0.677	1.529
OVERTEN	4.801	0.701	32.887
Q41	0.984	0.952	1.016

Hypotheses 6&13

The LOGISTIC Procedure

Response Variable	Q30EA

<q30ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	97.000

Probability Modeled Is Q30EA='1'.

R-Square	0.132	**Max-rescaled R-Square**	0.548

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	13.748	10.000	0.185
Score	16.040	10.000	0.099
Wald	5.041	10.000	0.888

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	1.779	9.188	0.038	0.847
Q27	0.138	0.699	0.039	0.844
Q28	0.898	0.736	1.490	0.222
Q3	-1.579	1.428	1.222	0.269
Q4	1.192	1.222	0.951	0.330
OWNALL	2.872	3.252	0.780	0.377
CROPS	-1.996	2.467	0.655	0.418
FLDFRRW	-7.203	5.231	1.896	0.169
Q43AGE	0.020	0.114	0.030	0.863
Q9	0.332	2.437	0.019	0.892
Q41	0.118	0.128	0.841	0.359

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	1.148	0.292	4.514
Q28	2.455	0.581	10.379
Q3	0.206	0.013	3.388
Q4	3.293	0.300	36.152
OWNALL	17.679	0.030	>999.999
CROPS	0.136	0.001	17.091
FLDFRRW	<0.001	<0.001	21.101
Q43AGE	1.020	0.815	1.276
Q9	1.394	0.012	165.521
Q41	1.125	0.875	1.447

Hypotheses 6&13

The LOGISTIC Procedure

Response Variable	Q30FA

<q30fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	67.000

Probability Modeled Is Q30FA='1'.

R-Square	0.222	**Max-rescaled R-Square**	0.296

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	16.784	17.000	0.469
Score	14.687	17.000	0.618
Wald	11.743	17.000	0.815

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-3.288	2.367	1.929	0.165
Q27	0.328	0.326	1.011	0.315
Q28	-0.014	0.320	0.002	0.965
Q3	0.026	0.315	0.007	0.935
Q4	0.089	0.332	0.073	0.788
OWNALL	-0.548	0.795	0.476	0.490
CROPS	0.702	0.946	0.550	0.459
DAIRYFM	1.907	1.462	1.702	0.192
LIVESTK	0.871	1.756	0.246	0.620
ORCHARD	-0.167	0.912	0.033	0.855
FLDFRRW	0.905	0.916	0.976	0.323
SPRNKLR	0.574	0.841	0.466	0.495
FAMOWN	0.779	0.747	1.089	0.297
Q43AGE	-0.019	0.032	0.334	0.564
Q9	0.263	0.855	0.095	0.758
Q11	-0.220	0.186	1.398	0.237
OVERTEN	1.197	1.166	1.053	0.305
Q41	0.000	0.017	0.001	0.980

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	1.388	0.732	2.631
Q28	0.986	0.527	1.847
Q3	1.026	0.554	1.902
Q4	1.094	0.571	2.095
OWNALL	0.578	0.122	2.743
CROPS	2.017	0.316	12.889
DAIRYFM	6.730	0.384	118.096
LIVESTK	2.388	0.076	74.653
ORCHARD	0.846	0.142	5.052
FLDFRRW	2.471	0.411	14.869
SPRNKLR	1.775	0.342	9.217
FAMOWN	2.180	0.504	9.423
Q43AGE	0.982	0.921	1.046
Q9	1.301	0.244	6.942
Q11	0.802	0.557	1.156
OVERTEN	3.309	0.337	32.516
Q41	1.000	0.966	1.034

Hypotheses 6&13

The LOGISTIC Procedure

Response Variable	Q30GA

<q30ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	111.000

Probability Modeled Is Q30GA='1'.

R-Square	0.189	**Max-rescaled R-Square**	0.397

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	23.253	14.000	0.056
Score	20.729	14.000	0.109
Wald	11.764	14.000	0.625

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-9.429	4.851	3.778	0.052
Q27	-0.017	0.461	0.001	0.970
Q28	0.605	0.552	1.201	0.273
Q3	0.411	0.403	1.040	0.308
Q4	-0.140	0.392	0.127	0.721
OWNALL	-0.724	0.967	0.561	0.454
CROPS	0.643	0.987	0.424	0.515
DAIRYFM	-1.247	1.437	0.753	0.386
FLDFRRW	2.222	1.146	3.758	0.053
SPRNKLR	-0.479	1.286	0.139	0.710
FAMOWN	1.017	1.240	0.673	0.412
Q43AGE	-0.135	0.075	3.234	0.072
Q9	-0.624	1.476	0.179	0.672
Q11	0.460	0.347	1.760	0.185
Q41	0.020	0.011	2.966	0.085

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	0.983	0.399	2.423
Q28	1.831	0.621	5.400
Q3	1.508	0.685	3.320
Q4	0.869	0.403	1.874
OWNALL	0.485	0.073	3.226
CROPS	1.902	0.275	13.151
DAIRYFM	0.287	0.017	4.804
FLDFRRW	9.224	0.976	87.207
SPRNKLR	0.619	0.050	7.706
FAMOWN	2.765	0.243	31.414
Q43AGE	0.874	0.755	1.012
Q9	0.536	0.030	9.661
Q11	1.584	0.803	3.124
Q41	1.020	0.997	1.043

Hypotheses 6&13

The REG Procedure

Dependent Variable: TTLBEHV <ttlbehv> Variable indicating the total number of behavioral changes that were implemented, with the maximum number possible being 7

Number of Observations Read	249.000
Number of Observations Used	112.000

R-Square	0.279
Adj R-Sq	0.158
Dependent Mean	3.732
Coeff Var	33.338

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	3.769	0.947	3.980	0.000
Q28	0.116	0.093	1.240	0.218
Q3	-0.114	0.111	-1.030	0.307
Q4	-0.030	0.102	-0.290	0.771
OWNALL	-0.556	0.298	-1.860	0.066
CROPS	-0.024	0.383	-0.060	0.951
DAIRYFM	-0.705	0.564	-1.250	0.214
LIVESTK	-1.213	0.806	-1.500	0.136
ORCHARD	0.178	0.353	0.500	0.615
FLDFRRW	-0.896	0.382	-2.350	0.021
SPRNKLR	-0.447	0.336	-1.330	0.187
FAMOWN	0.197	0.292	0.670	0.502
Q43AGE	-0.011	0.013	-0.820	0.413
Q9	0.053	0.399	0.130	0.894
Q11	0.099	0.077	1.280	0.204
OVERTEN	0.308	0.405	0.760	0.449
Q41	0.004	0.003	1.310	0.194

Hypothesis 7

The LOGISTIC Procedure

Response Variable Q31

<q31> During the last three years, have you looked into making any additional changes in the management of your irrigation system to minimize your WATER USE?

Number of Observations Read	249.000
Number of Observations Used	112.000

Probability Modeled Is Q31='1'.

R-Square	0.128	**Max-rescaled R-Square**	0.177

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	15.374	16.000	0.497
Score	14.317	16.000	0.575
Wald	12.385	16.000	0.717

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	0.068	1.755	0.002	0.969
Q28	-0.059	0.168	0.123	0.726
Q3	-0.087	0.209	0.175	0.676
Q4	0.338	0.189	3.184	0.074
OWNALL	-1.051	0.596	3.112	0.078
CROPS	-0.917	0.707	1.684	0.194
DAIRYFM	-1.607	0.993	2.617	0.106
LIVESTK	-0.532	1.421	0.140	0.708
ORCHARD	0.216	0.651	0.110	0.740
FLDFRRW	-0.080	0.685	0.014	0.907
SPRNKLR	-0.137	0.629	0.048	0.827
FAMOWN	0.755	0.513	2.165	0.141
Q43AGE	-0.031	0.023	1.754	0.185
Q9	0.777	0.743	1.093	0.296
Q11	0.056	0.144	0.152	0.696
OVERTEN	-0.751	0.804	0.872	0.350
Q41	0.006	0.007	0.606	0.436

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q28	0.943	0.678	1.310
Q3	0.916	0.608	1.381
Q4	1.401	0.967	2.030
OWNALL	0.349	0.109	1.124
CROPS	0.400	0.100	1.597
DAIRYFM	0.201	0.029	1.405
LIVESTK	0.588	0.036	9.516
ORCHARD	1.241	0.346	4.448
FLDFRRW	0.923	0.241	3.530
SPRNKLR	0.872	0.254	2.991
FAMOWN	2.126	0.778	5.810
Q43AGE	0.970	0.926	1.015
Q9	2.174	0.507	9.321
Q11	1.058	0.798	1.403
OVERTEN	0.472	0.098	2.282
Q41	1.006	0.992	1.020

Hypothesis 7

The LOGISTIC Procedure

Response Variable	Q32

<q32> During the past three years, have you looked into making any additional changes in the management of your ENERGY USE?

Number of Observations Read	249.000
Number of Observations Used	111.000

Probability Modeled Is Q32='1'.

R-Square	0.158	**Max-rescaled R-Square**	0.226

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	19.095	16.000	0.264
Score	18.222	16.000	0.311
Wald	15.343	16.000	0.500

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-1.107	1.824	0.368	0.544
Q28	0.293	0.184	2.532	0.112
Q3	0.096	0.201	0.226	0.635
Q4	0.180	0.194	0.863	0.353
OWNALL	-0.129	0.614	0.044	0.833
CROPS	-1.299	0.775	2.814	0.093
DAIRYFM	-0.696	1.029	0.457	0.499
LIVESTK	-0.404	1.521	0.070	0.791
ORCHARD	-0.384	0.722	0.283	0.595
FLDFRRW	-1.111	0.709	2.456	0.117
SPRNKLR	0.085	0.711	0.014	0.905
FAMOWN	1.078	0.537	4.038	0.045
Q43AGE	-0.011	0.026	0.170	0.680
Q9	0.401	0.775	0.268	0.605
Q11	-0.159	0.169	0.884	0.347
OVERTEN	-0.495	0.862	0.330	0.566
Q41	0.001	0.007	0.019	0.891

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q28	1.340	0.934	1.921
Q3	1.100	0.742	1.631
Q4	1.198	0.819	1.752
OWNALL	0.879	0.264	2.929
CROPS	0.273	0.060	1.245
DAIRYFM	0.499	0.066	3.748
LIVESTK	0.668	0.034	13.173
ORCHARD	0.681	0.165	2.802
FLDFRRW	0.329	0.082	1.321
SPRNKLR	1.089	0.270	4.389
FAMOWN	2.939	1.027	8.410
Q43AGE	0.989	0.940	1.041
Q9	1.493	0.327	6.811
Q11	0.853	0.613	1.188
OVERTEN	0.609	0.113	3.300
Q41	1.001	0.988	1.014

Hypothesis 7

The REG Procedure

Dependent Variable: Q32 <q32> During the past three years, have you looked into making any additional changes in the management of your ENERGY USE?

Number of Observations Read	249.000
Number of Observations Used	111.000
Number of Observations with Missing Values	138.000

R-Square	0.164
Adj R-Sq	0.022
Dependent Mean	0.712
Coeff Var	63.230

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	0.294	0.343	0.860	0.393
Q28	0.051	0.034	1.500	0.138
Q3	0.019	0.040	0.490	0.629
Q4	0.028	0.037	0.740	0.460
OWNALL	-0.016	0.110	-0.150	0.882
CROPS	-0.223	0.139	-1.600	0.112
DAIRYFM	-0.114	0.204	-0.560	0.578
LIVESTK	-0.050	0.292	-0.170	0.865
ORCHARD	-0.059	0.128	-0.460	0.646
FLDFRRW	-0.216	0.138	-1.560	0.122
SPRNKLR	0.019	0.123	0.160	0.876
FAMOWN	0.205	0.106	1.940	0.055
Q43AGE	-0.002	0.005	-0.350	0.724
Q9	0.067	0.144	0.470	0.642
Q11	-0.024	0.028	-0.850	0.398
OVERTEN	-0.079	0.147	-0.540	0.590
Q41	0.000	0.001	0.080	0.934

Hypothesis 8a

The LOGISTIC Procedure

Response Variable	Q30AA

<q30aa> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	219.000

Probability Modeled Is Q30AA='1'.

R-Square	0.159	**Max-rescaled R-Square**	0.229

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	37.878	15.000	0.001
Score	36.574	15.000	0.002
Wald	29.978	15.000	0.012

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	1.605	1.147	1.958	0.162
Q31	0.630	0.342	3.397	0.065
OWNALL	0.262	0.418	0.393	0.531
aware	0.015	0.153	0.009	0.924
CROPS	-0.119	0.509	0.055	0.815
DAIRYFM	-0.706	0.702	1.012	0.315
LIVESTK	-1.253	0.820	2.334	0.127
ORCHARD	0.443	0.492	0.810	0.368
FLDFRRW	-1.018	0.451	5.101	0.024
SPRNKLR	-0.296	0.520	0.324	0.569
FAMOWN	0.251	0.461	0.297	0.586
Q43AGE	-0.004	0.014	0.105	0.746
Q9	-0.612	0.408	2.254	0.133
Q11	0.128	0.086	2.232	0.135
OVERTEN	-0.884	0.625	2.003	0.157
Q41	0.007	0.010	0.532	0.466

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q31	1.878	0.961	3.672
OWNALL	1.300	0.572	2.951
aware	1.015	0.752	1.368
CROPS	0.888	0.328	2.405
DAIRYFM	0.494	0.125	1.953
LIVESTK	0.286	0.057	1.425
ORCHARD	1.557	0.594	4.080
FLDFRRW	0.361	0.149	0.874
SPRNKLR	0.744	0.268	2.061
FAMOWN	1.286	0.521	3.173
Q43AGE	0.996	0.969	1.022
Q9	0.542	0.244	1.206
Q11	1.136	0.961	1.344
OVERTEN	0.413	0.121	1.405
Q41	1.007	0.988	1.026

Hypothesis 8a

The LOGISTIC Procedure

Response Variable	Q30BA

<q30ba> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	218.000

Probability Modeled Is Q30BA='1'.

R-Square	0.189	**Max-rescaled R-Square**	0.252

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	45.666	15.000	<.0001
Score	40.426	15.000	0.000
Wald	32.056	15.000	0.006

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	0.541	1.006	0.289	0.591
Q31	0.570	0.315	3.269	0.071
OWNALL	0.135	0.389	0.121	0.728
aware	0.175	0.132	1.771	0.183
CROPS	-0.024	0.466	0.003	0.959
DAIRYFM	-0.099	0.712	0.020	0.889
LIVESTK	-2.137	1.149	3.461	0.063
ORCHARD	0.426	0.421	1.024	0.312
FLDFRRW	-0.747	0.408	3.350	0.067
SPRNKLR	-0.287	0.447	0.414	0.520
FAMOWN	-0.076	0.411	0.034	0.853
Q43AGE	0.001	0.013	0.012	0.912
Q9	-1.189	0.429	7.670	0.006
Q11	0.088	0.078	1.276	0.259
OVERTEN	-0.889	0.516	2.968	0.085
Q41	0.013	0.009	1.868	0.172

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q31	1.768	0.953	3.278
OWNALL	1.145	0.534	2.453
aware	1.192	0.920	1.542
CROPS	0.977	0.392	2.433
DAIRYFM	0.905	0.224	3.653
LIVESTK	0.118	0.012	1.121
ORCHARD	1.531	0.671	3.496
FLDFRRW	0.474	0.213	1.054
SPRNKLR	0.750	0.313	1.800
FAMOWN	0.927	0.414	2.072
Q43AGE	1.001	0.976	1.027
Q9	0.304	0.131	0.706
Q11	1.092	0.937	1.273
OVERTEN	0.411	0.150	1.130
Q41	1.013	0.995	1.031

Hypothesis 8a

The LOGISTIC Procedure

Response Variable	Q30CA

<q30ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	167.000

Probability Modeled Is Q30CA='1'.

R-Square	0.157	**Max-rescaled R-Square**	0.407

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	28.439	11.000	0.003
Score	33.742	11.000	0.000
Wald	17.570	11.000	0.092

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	7.623	2.493	9.354	0.002
Q31	0.817	0.838	0.952	0.329
OWNALL	-1.516	1.050	2.085	0.149
aware	-0.346	0.334	1.073	0.300
CROPS	-2.132	0.891	5.725	0.017
FLDFRRW	-1.128	0.903	1.561	0.212
SPRNKLR	1.992	1.366	2.125	0.145
FAMOWN	0.582	1.137	0.262	0.609
Q9	-2.613	0.959	7.422	0.006
Q11	-0.054	0.196	0.077	0.781
OVERTEN	1.695	1.081	2.458	0.117
Q41	0.017	0.031	0.284	0.594

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q31	2.264	0.439	11.687
OWNALL	0.220	0.028	1.719
aware	0.708	0.368	1.361
CROPS	0.119	0.021	0.680
FLDFRRW	0.324	0.055	1.900
SPRNKLR	7.329	0.503	106.691
FAMOWN	1.790	0.193	16.611
Q9	0.073	0.011	0.480
Q11	0.947	0.645	1.390
OVERTEN	5.449	0.654	45.373
Q41	1.017	0.956	1.081

Hypothesis 8a

The LOGISTIC Procedure

Response Variable	Q30DA

<q30da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	101.000

Probability Modeled Is Q30DA='1'.

R-Square	0.094	**Max-rescaled R-Square**	0.126

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	10.012	12.000	0.615
Score	9.559	12.000	0.655
Wald	8.707	12.000	0.728

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-0.270	1.531	0.031	0.860
Q31	-0.216	0.483	0.200	0.655
OWNALL	-0.482	0.512	0.886	0.347
aware	-0.045	0.197	0.053	0.819
CROPS	0.662	0.538	1.512	0.219
FLDFRRW	-0.359	0.657	0.299	0.585
SPRNKLR	0.292	0.508	0.331	0.565
FAMOWN	0.289	0.561	0.266	0.606
Q43AGE	-0.008	0.019	0.170	0.680
Q9	-0.636	0.617	1.064	0.302
Q11	0.110	0.114	0.932	0.334
OVERTEN	1.119	0.710	2.481	0.115
Q41	-0.008	0.010	0.610	0.435

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q31	0.806	0.313	2.076
OWNALL	0.617	0.226	1.685
aware	0.956	0.649	1.407
CROPS	1.938	0.675	5.566
FLDFRRW	0.698	0.193	2.529
SPRNKLR	1.339	0.495	3.626
FAMOWN	1.336	0.445	4.013
Q43AGE	0.992	0.955	1.030
Q9	0.529	0.158	1.773
Q11	1.116	0.893	1.394
OVERTEN	3.061	0.761	12.310
Q41	0.992	0.974	1.011

Hypothesis 8a

The LOGISTIC Procedure

Response Variable	Q30EA

<q30ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	167.000

Probability Modeled Is Q30EA='1'.

R-Square	0.187	**Max-rescaled R-Square**	0.512

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	34.466	12.000	0.001
Score	42.300	12.000	<.0001
Wald	15.648	12.000	0.208

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	5.431	2.849	3.635	0.057
Q31	2.350	1.154	4.143	0.042
OWNALL	-1.461	1.187	1.515	0.218
aware	-0.044	0.374	0.014	0.906
CROPS	-3.379	1.224	7.617	0.006
FLDFRRW	-2.141	1.285	2.776	0.096
SPRNKLR	0.276	1.230	0.051	0.822
FAMOWN	-0.580	1.648	0.124	0.725
Q43AGE	0.001	0.045	0.001	0.980
Q9	-2.630	1.004	6.861	0.009
Q11	0.267	0.266	1.009	0.315
OVERTEN	2.479	1.306	3.606	0.058
Q41	0.008	0.031	0.075	0.785

Odds Ratio Estimates

Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Q31	10.481	1.091	100.680
OWNALL	0.232	0.023	2.376
aware	0.957	0.460	1.991
CROPS	0.034	0.003	0.376
FLDFRRW	0.118	0.009	1.458
SPRNKLR	1.318	0.118	14.672
FAMOWN	0.560	0.022	14.154
Q43AGE	1.001	0.916	1.094
Q9	0.072	0.010	0.516
Q11	1.306	0.776	2.197
OVERTEN	11.933	0.923	154.196
Q41	1.008	0.949	1.071

Hypothesis 8a

The LOGISTIC Procedure

Response Variable	Q30FA

<q30fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	142.000

Probability Modeled Is Q30FA='1'.

R-Square	0.135	**Max-rescaled R-Square**	0.180

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	20.643	15.000	0.149
Score	19.441	15.000	0.194
Wald	17.251	15.000	0.304

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-1.101	1.410	0.610	0.435
Q31	0.109	0.395	0.076	0.784
OWNALL	0.022	0.457	0.002	0.962
aware	0.257	0.190	1.830	0.176
CROPS	1.350	0.557	5.872	0.015
DAIRYFM	2.291	0.839	7.461	0.006
LIVESTK	1.419	0.882	2.588	0.108
ORCHARD	0.770	0.510	2.277	0.131
FLDFRRW	0.048	0.457	0.011	0.917
SPRNKLR	-0.334	0.602	0.307	0.579
FAMOWN	0.464	0.528	0.771	0.380
Q43AGE	-0.003	0.016	0.040	0.841
Q9	-0.799	0.470	2.885	0.089
Q11	-0.116	0.094	1.545	0.214
OVERTEN	-0.237	0.647	0.134	0.714
Q41	0.004	0.012	0.126	0.723

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q31	1.115	0.514	2.418
OWNALL	1.022	0.417	2.502
aware	1.293	0.891	1.876
CROPS	3.858	1.295	11.498
DAIRYFM	9.888	1.910	51.180
LIVESTK	4.133	0.734	23.286
ORCHARD	2.159	0.795	5.866
FLDFRRW	1.049	0.428	2.569
SPRNKLR	0.716	0.220	2.331
FAMOWN	1.590	0.565	4.478
Q43AGE	0.997	0.966	1.028
Q9	0.450	0.179	1.131
Q11	0.890	0.741	1.069
OVERTEN	0.789	0.222	2.804
Q41	1.004	0.980	1.029

Hypothesis 8a

The LOGISTIC Procedure

Response Variable	Q30GA

<q30ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	221.000

Probability Modeled Is Q30GA='1'.

R-Square	0.082	**Max-rescaled R-Square**	0.160

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	18.964	15.000	0.215
Score	17.580	15.000	0.285
Wald	14.874	15.000	0.461

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-3.912	1.949	4.030	0.045
Q31	0.125	0.476	0.069	0.794
OWNALL	-0.496	0.511	0.943	0.332
aware	0.115	0.217	0.280	0.597
CROPS	0.758	0.674	1.264	0.261
DAIRYFM	-0.523	1.216	0.185	0.667
LIVESTK	0.121	1.254	0.009	0.923
ORCHARD	0.600	0.639	0.882	0.348
FLDFRRW	0.632	0.550	1.318	0.251
SPRNKLR	-1.284	0.857	2.246	0.134
FAMOWN	1.585	1.053	2.265	0.132
Q43AGE	-0.021	0.021	1.002	0.317
Q9	-0.336	0.600	0.314	0.575
Q11	-0.049	0.109	0.205	0.651
OVERTEN	0.469	0.815	0.331	0.565
Q41	0.008	0.005	2.000	0.157

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q31	1.133	0.445	2.881
OWNALL	0.609	0.224	1.657
aware	1.122	0.733	1.718
CROPS	2.134	0.569	7.998
DAIRYFM	0.593	0.055	6.419
LIVESTK	1.129	0.097	13.170
ORCHARD	1.821	0.521	6.366
FLDFRRW	1.881	0.640	5.528
SPRNKLR	0.277	0.052	1.484
FAMOWN	4.878	0.619	38.412
Q43AGE	0.979	0.939	1.021
Q9	0.714	0.221	2.314
Q11	0.952	0.769	1.179
OVERTEN	1.599	0.323	7.903
Q41	1.008	0.997	1.018

Hypothesis 8a

The REG Procedure

Dependent Variable: TTLBEHV <ttlbehv> Variable indicating the total number of behavioral changes that were implemented, with the maximum number possible being 7

Number of Observations Read	249.000
Number of Observations Used	222.000

R-Square	0.390
Adj R-Sq	0.345
Dependent Mean	3.252
Coeff Var	38.966

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.458	0.579	7.700	<.0001
Q31	0.603	0.179	3.360	0.001
OWNALL	-0.334	0.211	-1.580	0.115
aware	0.018	0.075	0.240	0.809
CROPS	-0.014	0.262	-0.050	0.957
DAIRYFM	0.005	0.400	0.010	0.990
LIVESTK	-1.136	0.449	-2.530	0.012
ORCHARD	0.226	0.239	0.950	0.346
FLDFRRW	-1.124	0.230	-4.900	<.0001
SPRNKLR	-0.300	0.253	-1.190	0.237
FAMOWN	0.199	0.234	0.850	0.397
Q43AGE	-0.001	0.007	-0.130	0.897
Q9	-1.090	0.231	-4.720	<.0001
Q11	0.034	0.044	0.760	0.448
OVERTEN	-0.016	0.274	-0.060	0.953
Q41	0.004	0.003	1.500	0.136

Hypothesis 8b

The LOGISTIC Procedure

Response Variable	Q30AA

<q30aa> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	217.000

Probability Modeled Is Q30AA='1'.

R-Square	0.148	**Max-rescaled R-Square**	0.214

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	34.841	15.000	0.003
Score	33.598	15.000	0.004
Wald	28.052	15.000	0.021

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	1.635	1.141	2.054	0.152
Q32	0.597	0.343	3.030	0.082
OWNALL	0.278	0.425	0.427	0.514
aware	0.000	0.153	0.000	0.999
CROPS	-0.081	0.506	0.026	0.872
DAIRYFM	-0.713	0.696	1.050	0.306
LIVESTK	-1.137	0.855	1.770	0.183
ORCHARD	0.450	0.487	0.856	0.355
FLDFRRW	-0.972	0.450	4.672	0.031
SPRNKLR	-0.357	0.521	0.468	0.494
FAMOWN	0.239	0.458	0.271	0.602
Q43AGE	-0.003	0.013	0.057	0.812
Q9	-0.591	0.410	2.086	0.149
Q11	0.140	0.085	2.702	0.100
OVERTEN	-0.996	0.623	2.559	0.110
Q41	0.008	0.010	0.645	0.422

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q32	1.817	0.927	3.560
OWNALL	1.320	0.574	3.035
aware	1.000	0.741	1.350
CROPS	0.922	0.342	2.484
DAIRYFM	0.490	0.125	1.917
LIVESTK	0.321	0.060	1.713
ORCHARD	1.569	0.605	4.071
FLDFRRW	0.378	0.157	0.913
SPRNKLR	0.700	0.252	1.945
FAMOWN	1.269	0.517	3.114
Q43AGE	0.997	0.971	1.023
Q9	0.554	0.248	1.235
Q11	1.151	0.973	1.360
OVERTEN	0.369	0.109	1.252
Q41	1.008	0.988	1.029

Hypothesis 8b

The LOGISTIC Procedure

Response Variable	Q30BA

<q30ba> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	216.000

Probability Modeled Is Q30BA='1'.

R-Square	0.181	**Max-rescaled R-Square**	0.241

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	42.991	15.000	0.000
Score	38.344	15.000	0.001
Wald	30.311	15.000	0.011

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	0.639	1.001	0.408	0.523
Q32	0.114	0.324	0.123	0.726
OWNALL	0.028	0.394	0.005	0.943
aware	0.207	0.133	2.419	0.120
CROPS	0.029	0.467	0.004	0.950
DAIRYFM	-0.149	0.711	0.044	0.834
LIVESTK	-1.991	1.164	2.924	0.087
ORCHARD	0.596	0.422	1.992	0.158
FLDFRRW	-0.814	0.413	3.882	0.049
SPRNKLR	-0.452	0.447	1.021	0.312
FAMOWN	-0.059	0.411	0.021	0.885
Q43AGE	0.001	0.013	0.009	0.923
Q9	-1.178	0.428	7.591	0.006
Q11	0.104	0.077	1.811	0.179
OVERTEN	-0.962	0.511	3.541	0.060
Q41	0.015	0.010	2.278	0.131

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q32	1.120	0.594	2.113
OWNALL	1.028	0.475	2.226
aware	1.230	0.948	1.596
CROPS	1.030	0.413	2.570
DAIRYFM	0.862	0.214	3.472
LIVESTK	0.137	0.014	1.338
ORCHARD	1.814	0.793	4.149
FLDFRRW	0.443	0.197	0.996
SPRNKLR	0.636	0.265	1.529
FAMOWN	0.942	0.421	2.109
Q43AGE	1.001	0.977	1.027
Q9	0.308	0.133	0.712
Q11	1.110	0.954	1.291
OVERTEN	0.382	0.140	1.041
Q41	1.015	0.995	1.035

Hypothesis 8b

The LOGISTIC Procedure

Response Variable	Q30CA

<q30ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	166.000

Probability Modeled Is Q30CA='1'.

R-Square	0.158	**Max-rescaled R-Square**	0.410

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	28.577	11.000	0.003
Score	33.277	11.000	0.001
Wald	17.761	11.000	0.087

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	8.557	2.626	10.621	0.001
Q32	-0.934	0.882	1.122	0.290
OWNALL	-1.637	1.028	2.536	0.111
aware	-0.288	0.323	0.795	0.373
CROPS	-2.149	0.877	6.007	0.014
FLDFRRW	-1.134	0.904	1.572	0.210
SPRNKLR	2.216	1.366	2.633	0.105
FAMOWN	0.964	1.119	0.743	0.389
Q9	-3.025	1.000	9.141	0.003
Q11	-0.005	0.187	0.001	0.980
OVERTEN	1.501	1.062	1.997	0.158
Q41	0.018	0.033	0.307	0.579

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q32	0.393	0.070	2.213
OWNALL	0.195	0.026	1.459
aware	0.750	0.398	1.412
CROPS	0.117	0.021	0.650
FLDFRRW	0.322	0.055	1.894
SPRNKLR	9.172	0.631	133.338
FAMOWN	2.623	0.293	23.510
Q9	0.049	0.007	0.345
Q11	0.995	0.689	1.437
OVERTEN	4.484	0.559	35.943
Q41	1.018	0.955	1.086

Hypothesis 8b

The LOGISTIC Procedure

Response Variable	Q30DA

<q30da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	100.000

Probability Modeled Is Q30DA='1'.

R-Square	0.103	**Max-rescaled R-Square**	0.137

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	10.812	12.000	0.545
Score	10.323	12.000	0.588
Wald	9.408	12.000	0.668

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	0.089	1.620	0.003	0.956
Q32	-0.448	0.512	0.766	0.381
OWNALL	-0.554	0.517	1.147	0.284
aware	-0.012	0.198	0.004	0.952
CROPS	0.544	0.546	0.995	0.319
FLDFRRW	-0.454	0.637	0.507	0.476
SPRNKLR	0.265	0.513	0.266	0.606
FAMOWN	0.367	0.574	0.409	0.523
Q43AGE	-0.011	0.020	0.294	0.588
Q9	-0.777	0.648	1.436	0.231
Q11	0.094	0.114	0.691	0.406
OVERTEN	1.083	0.716	2.289	0.130
Q41	-0.007	0.010	0.604	0.437

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits
0.639	0.234	1.742
0.575	0.209	1.583
0.988	0.671	1.455
1.723	0.591	5.020
0.635	0.182	2.215
1.303	0.476	3.564
1.443	0.469	4.444
0.989	0.952	1.028
0.460	0.129	1.638
1.099	0.880	1.373
2.952	0.726	12.001
0.993	0.974	1.011

Hypothesis 8b

The LOGISTIC Procedure

Response Variable	Q30EA

<q30ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	166.000

Probability Modeled Is Q30EA='1'.

R-Square	0.163	**Max-rescaled R-Square**	0.445

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	29.511	12.000	0.003
Score	39.551	12.000	<.0001
Wald	17.011	12.000	0.149

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	5.748	2.807	4.193	0.041
Q32	-0.427	0.908	0.221	0.638
OWNALL	-1.252	1.009	1.540	0.215
aware	0.052	0.344	0.023	0.881
CROPS	-2.657	0.971	7.497	0.006
FLDFRRW	-1.340	1.090	1.512	0.219
SPRNKLR	0.132	1.154	0.013	0.909
FAMOWN	-0.066	1.395	0.002	0.963
Q43AGE	0.015	0.044	0.109	0.742
Q9	-2.997	1.016	8.694	0.003
Q11	0.297	0.222	1.780	0.182
OVERTEN	1.669	1.108	2.268	0.132
Q41	0.016	0.034	0.234	0.628

Odds Ratio Estimates

Effect	**Point Estimate**	**95% Wald Confidence Limits**
0.652	0.110	3.870
0.286	0.040	2.066
1.053	0.536	2.068
0.070	0.010	0.470
0.262	0.031	2.217
1.141	0.119	10.945
0.937	0.061	14.406
1.015	0.931	1.106
0.050	0.007	0.366
1.345	0.870	2.080
5.307	0.605	46.569
1.016	0.952	1.085

Hypothesis 8b

The LOGISTIC Procedure

Response Variable Q30FA
<q30fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	140.000

Probability Modeled Is Q30FA='1'.

R-Square	0.159	**Max-rescaled R-Square**	0.211

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	24.159	15.000	0.062
Score	22.427	15.000	0.097
Wald	19.340	15.000	0.199

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-1.516	1.427	1.129	0.288
Q32	0.894	0.424	4.450	0.035
OWNALL	0.237	0.474	0.249	0.618
aware	0.234	0.190	1.524	0.217
CROPS	1.511	0.577	6.865	0.009
DAIRYFM	2.569	0.867	8.787	0.003
LIVESTK	1.196	0.958	1.559	0.212
ORCHARD	0.731	0.523	1.955	0.162
FLDFRRW	0.136	0.468	0.085	0.771
SPRNKLR	-0.366	0.616	0.352	0.553
FAMOWN	0.380	0.533	0.507	0.476
Q43AGE	0.001	0.016	0.005	0.946
Q9	-0.761	0.485	2.462	0.117
Q11	-0.126	0.097	1.708	0.191
OVERTEN	-0.467	0.664	0.496	0.482
Q41	0.004	0.013	0.114	0.736

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
2.446	1.065	5.614	
1.267	0.500	3.211	
1.264	0.871	1.834	
4.530	1.463	14.025	
13.047	2.388	71.292	
3.306	0.506	21.596	
2.077	0.746	5.786	
1.146	0.458	2.868	
0.694	0.207	2.321	
1.461	0.514	4.152	
1.001	0.970	1.033	
0.467	0.181	1.209	
0.881	0.729	1.065	
0.627	0.171	2.303	
1.004	0.979	1.030	

Hypothesis 8b

The LOGISTIC Procedure

Response Variable	Q30GA

<q30ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	219.000

Probability Modeled Is Q30GA='1'.

R-Square	0.077	**Max-rescaled R-Square**	0.151

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	17.537	15.000	0.288
Score	16.424	15.000	0.355
Wald	13.955	15.000	0.529

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-3.868	1.945	3.955	0.047
Q32	-0.057	0.484	0.014	0.907
OWNALL	-0.416	0.534	0.609	0.435
aware	0.093	0.221	0.176	0.675
CROPS	0.747	0.674	1.228	0.268
DAIRYFM	-0.648	1.214	0.285	0.593
LIVESTK	0.415	1.262	0.108	0.742
ORCHARD	0.484	0.649	0.556	0.456
FLDFRRW	0.725	0.565	1.648	0.199
SPRNKLR	-1.178	0.870	1.833	0.176
FAMOWN	1.581	1.053	2.252	0.134
Q43AGE	-0.020	0.021	0.922	0.337
Q9	-0.284	0.605	0.220	0.639
Q11	-0.045	0.109	0.173	0.678
OVERTEN	0.487	0.820	0.352	0.553
Q41	0.008	0.005	1.974	0.160

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
0.945	0.366	2.440	
0.659	0.232	1.877	
1.097	0.712	1.691	
2.110	0.563	7.908	
0.523	0.048	5.647	
1.515	0.128	17.979	
1.623	0.454	5.793	
2.065	0.682	6.250	
0.308	0.056	1.695	
4.858	0.616	38.293	
0.980	0.940	1.021	
0.753	0.230	2.463	
0.956	0.771	1.184	
1.627	0.326	8.124	
1.008	0.997	1.018	

Hypothesis 8b

The REG Procedure

Dependent Variable: TTLBEHV <ttlbehv> Variable indicating the total number of behavioral changes that were implemented, with the maximum number possible being 7

Number of Observations Read	249.000
Number of Observations Used	222.000

R-Square	0.356
Adj R-Sq	0.312
Dependent Mean	3.252
Coeff Var	39.925

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.717	0.588	8.030	<.0001
OWNALL	-0.384	0.216	-1.780	0.077
aware	0.033	0.076	0.430	0.666
CROPS	0.028	0.268	0.100	0.917
DAIRYFM	-0.065	0.409	-0.160	0.874
LIVESTK	-1.060	0.460	-2.310	0.022
ORCHARD	0.327	0.243	1.350	0.180
FLDFRRW	-1.133	0.235	-4.820	<.0001
SPRNKLR	-0.360	0.258	-1.400	0.164
FAMOWN	0.220	0.240	0.920	0.361
Q43AGE	0.000	0.007	0.000	0.999
Q9	-1.151	0.236	-4.880	<.0001
Q11	0.055	0.045	1.230	0.220
OVERTEN	-0.083	0.280	-0.290	0.769
Q41	0.005	0.003	1.790	0.076

Hypothesis 9a

The LOGISTIC Procedure

Response Variable	Q29BA

<q29ba> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	218.000

Probability Modeled Is Q29BA='1'.

R-Square	0.204	**Max-rescaled R-Square**	0.272

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	49.750	15.000	<.0001
Score	42.897	15.000	0.000
Wald	33.776	15.000	0.004

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-0.420	1.025	0.168	0.682
Q33	0.183	0.328	0.312	0.577
OWNALL	-0.090	0.398	0.051	0.822
aware	0.158	0.134	1.404	0.236
CROPS	-0.940	0.483	3.798	0.051
DAIRYFM	-2.006	0.881	5.190	0.023
LIVESTK	-2.287	1.122	4.154	0.042
ORCHARD	-0.120	0.417	0.082	0.774
FLDFRRW	-0.823	0.412	3.999	0.046
SPRNKLR	-0.211	0.443	0.228	0.633
FAMOWN	0.579	0.420	1.900	0.168
Q43AGE	-0.009	0.013	0.495	0.482
Q9	-0.717	0.425	2.843	0.092
Q11	0.080	0.078	1.057	0.304
OVERTEN	0.103	0.489	0.044	0.834
Q41	0.022	0.012	3.336	0.068

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q33	1.201	0.632	2.284
OWNALL	0.914	0.419	1.993
aware	1.172	0.902	1.522
CROPS	0.390	0.152	1.005
DAIRYFM	0.135	0.024	0.756
LIVESTK	0.102	0.011	0.916
ORCHARD	0.887	0.392	2.008
FLDFRRW	0.439	0.196	0.984
SPRNKLR	0.809	0.340	1.930
FAMOWN	1.784	0.783	4.063
Q43AGE	0.991	0.967	1.016
Q9	0.488	0.212	1.123
Q11	1.083	0.930	1.262
OVERTEN	1.108	0.425	2.887
Q41	1.022	0.998	1.047

Hypothesis 9a

The LOGISTIC Procedure

Response Variable	Q29CA

<q29ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	211.000

Probability Modeled Is Q29CA='1'.

R-Square	0.255	**Max-rescaled R-Square**	0.340

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	62.119	15.000	<.0001
Score	53.797	15.000	<.0001
Wald	41.487	15.000	0.000

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	2.799	1.138	6.047	0.014
Q33	0.352	0.349	1.017	0.313
OWNALL	-0.453	0.411	1.216	0.270
aware	-0.230	0.145	2.530	0.112
CROPS	0.381	0.518	0.543	0.461
DAIRYFM	0.310	0.808	0.147	0.701
LIVESTK	-1.628	1.161	1.967	0.161
ORCHARD	0.798	0.453	3.102	0.078
FLDFRRW	-1.834	0.443	17.123	<.0001
SPRNKLR	-1.075	0.480	5.009	0.025
FAMOWN	0.407	0.439	0.860	0.354
Q43AGE	0.016	0.014	1.304	0.254
Q9	-1.364	0.481	8.057	0.005
Q11	-0.118	0.085	1.940	0.164
OVERTEN	0.816	0.568	2.061	0.151
Q41	0.005	0.007	0.488	0.485

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q33	1.422	0.717	2.821
OWNALL	0.635	0.284	1.422
aware	0.794	0.598	1.055
CROPS	1.464	0.531	4.037
DAIRYFM	1.363	0.280	6.637
LIVESTK	0.196	0.020	1.910
ORCHARD	2.221	0.914	5.399
FLDFRRW	0.160	0.067	0.381
SPRNKLR	0.341	0.133	0.875
FAMOWN	1.503	0.635	3.555
Q43AGE	1.016	0.989	1.043
Q9	0.256	0.100	0.656
Q11	0.889	0.753	1.049
OVERTEN	2.261	0.742	6.886
Q41	1.005	0.991	1.019

Hypothesis 9a

The LOGISTIC Procedure

Response Variable Q29DA

<q29da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	201.000

Probability Modeled Is Q29DA='1'.

R-Square	0.067	**Max-rescaled R-Square**	0.093

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	14.006	15.000	0.525
Score	13.188	15.000	0.588
Wald	12.266	15.000	0.659

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-2.375	1.206	3.882	0.049
Q33	0.181	0.331	0.298	0.585
OWNALL	0.124	0.390	0.101	0.750
aware	0.047	0.147	0.101	0.750
CROPS	0.705	0.509	1.919	0.166
DAIRYFM	1.263	0.712	3.148	0.076
LIVESTK	0.222	0.904	0.060	0.806
ORCHARD	1.082	0.449	5.807	0.016
FLDFRRW	-0.934	0.431	4.697	0.030
SPRNKLR	-0.582	0.458	1.617	0.204
FAMOWN	0.247	0.452	0.299	0.585
Q43AGE	0.019	0.013	2.175	0.140
Q9	0.194	0.409	0.226	0.635
Q11	-0.027	0.080	0.117	0.732
OVERTEN	0.457	0.563	0.660	0.417
Q41	0.001	0.006	0.062	0.803

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q33	1.198	0.627	2.290
OWNALL	1.132	0.527	2.431
aware	1.048	0.785	1.399
CROPS	2.023	0.747	5.480
DAIRYFM	3.538	0.876	14.285
LIVESTK	1.249	0.212	7.344
ORCHARD	2.951	1.224	7.114
FLDFRRW	0.393	0.169	0.915
SPRNKLR	0.559	0.228	1.370
FAMOWN	1.280	0.528	3.105
Q43AGE	1.019	0.994	1.045
Q9	1.214	0.545	2.706
Q11	0.973	0.832	1.138
OVERTEN	1.580	0.524	4.758
Q41	1.001	0.990	1.013

Hypothesis 9a

The LOGISTIC Procedure

Response Variable	Q29EA

<q29ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	211.000

Probability Modeled Is Q29EA='1'.

R-Square	0.118	**Max-rescaled R-Square**	0.160

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	26.592	15.000	0.032
Score	25.099	15.000	0.049
Wald	22.587	15.000	0.093

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-0.486	1.006	0.233	0.629
Q33	0.906	0.318	8.107	0.004
OWNALL	-0.234	0.366	0.409	0.522
aware	-0.013	0.134	0.009	0.926
CROPS	0.753	0.460	2.685	0.101
DAIRYFM	-0.328	0.741	0.196	0.658
LIVESTK	0.663	0.854	0.604	0.437
ORCHARD	0.313	0.423	0.548	0.459
FLDFRRW	0.037	0.407	0.008	0.927
SPRNKLR	0.177	0.444	0.159	0.690
FAMOWN	0.530	0.411	1.667	0.197
Q43AGE	0.001	0.013	0.011	0.916
Q9	-0.948	0.437	4.709	0.030
Q11	0.083	0.080	1.084	0.298
OVERTEN	-0.232	0.465	0.249	0.618
Q41	0.002	0.005	0.192	0.662

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q33	2.473	1.326	4.613
OWNALL	0.791	0.386	1.622
aware	0.988	0.759	1.284
CROPS	2.124	0.863	5.231
DAIRYFM	0.720	0.168	3.078
LIVESTK	1.941	0.364	10.345
ORCHARD	1.368	0.597	3.131
FLDFRRW	1.038	0.468	2.302
SPRNKLR	1.194	0.500	2.852
FAMOWN	1.699	0.760	3.800
Q43AGE	1.001	0.976	1.027
Q9	0.388	0.165	0.912
Q11	1.087	0.929	1.272
OVERTEN	0.793	0.318	1.973
Q41	1.002	0.993	1.012

Hypothesis 9a

The LOGISTIC Procedure

Response Variable	Q29FA

<q29fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	200.000

Probability Modeled Is Q29FA='1'.

R-Square	0.273	**Max-rescaled R-Square**	0.364

Testing Global Null Hypothesis: BETA=0

Test	**Chi-Square**	**DF**	**Pr > Chi Sq**
Likelihood Ratio	63.689	12.000	<.0001
Score	55.116	12.000	<.0001
Wald	41.618	12.000	<.0001

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	2.382	1.138	4.384	0.036
Q33	0.469	0.371	1.600	0.206
OWNALL	-0.485	0.433	1.255	0.263
aware	-0.145	0.147	0.970	0.325
CROPS	-0.018	0.480	0.001	0.970
FLDFRRW	-2.306	0.448	26.535	<.0001
SPRNKLR	-0.917	0.427	4.602	0.032
FAMOWN	-0.086	0.438	0.038	0.845
Q43AGE	0.005	0.014	0.135	0.713
Q9	-1.405	0.529	7.062	0.008
Q11	-0.087	0.088	0.967	0.326
OVERTEN	1.431	0.573	6.249	0.012
Q41	0.013	0.011	1.273	0.259

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q33	1.598	0.773	3.306
OWNALL	0.616	0.263	1.438
aware	0.865	0.649	1.154
CROPS	0.982	0.384	2.516
FLDFRRW	0.100	0.041	0.240
SPRNKLR	0.400	0.173	0.924
FAMOWN	0.918	0.389	2.165
Q43AGE	1.005	0.978	1.033
Q9	0.245	0.087	0.692
Q11	0.917	0.772	1.090
OVERTEN	4.185	1.362	12.855
Q41	1.013	0.991	1.035

Hypothesis 9a

The LOGISTIC Procedure

Response Variable	Q29GA

<q29ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	208.000

Probability Modeled Is Q29GA='1'.

R-Square	0.195	**Max-rescaled R-Square**	0.291

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	44.993	15.000	<.0001
Score	36.225	15.000	0.002
Wald	27.434	15.000	0.025

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-0.758	1.227	0.381	0.537
Q33	-0.061	0.399	0.023	0.879
OWNALL	-0.898	0.551	2.657	0.103
aware	0.249	0.161	2.387	0.122
CROPS	0.808	0.591	1.868	0.172
DAIRYFM	1.022	0.873	1.372	0.242
LIVESTK	2.201	1.267	3.016	0.082
ORCHARD	0.856	0.523	2.684	0.101
FLDFRRW	0.142	0.525	0.073	0.787
SPRNKLR	-0.963	0.559	2.970	0.085
FAMOWN	0.217	0.529	0.168	0.682
Q43AGE	0.006	0.014	0.194	0.660
Q9	-0.955	0.487	3.857	0.050
Q11	-0.047	0.096	0.240	0.624
OVERTEN	1.546	0.530	8.524	0.004
Q41	0.067	0.027	5.881	0.015

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q33	0.941	0.430	2.058
OWNALL	0.407	0.138	1.199
aware	1.283	0.935	1.761
CROPS	2.243	0.704	7.145
DAIRYFM	2.779	0.502	15.368
LIVESTK	9.033	0.754	108.290
ORCHARD	2.354	0.845	6.557
FLDFRRW	1.153	0.412	3.223
SPRNKLR	0.382	0.128	1.141
FAMOWN	1.242	0.440	3.503
Q43AGE	1.006	0.978	1.035
Q9	0.385	0.148	0.998
Q11	0.954	0.790	1.152
OVERTEN	4.694	1.662	13.254
Q41	1.069	1.013	1.128

Hypothesis 9a

The LOGISTIC Procedure

Response Variable	Q29HA

<q29ha> Did you regularly adjust bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	201.000

Probability Modeled Is Q29HA='1'.

R-Square	0.142	**Max-rescaled R-Square**	0.195

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	30.848	15.000	0.009
Score	28.726	15.000	0.017
Wald	24.426	15.000	0.058

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-2.704	1.274	4.502	0.034
Q33	0.636	0.339	3.532	0.060
OWNALL	0.605	0.414	2.139	0.144
aware	0.365	0.167	4.788	0.029
CROPS	0.845	0.496	2.905	0.088
DAIRYFM	0.412	0.713	0.334	0.563
LIVESTK	0.322	0.925	0.121	0.728
ORCHARD	0.171	0.457	0.141	0.708
FLDFRRW	0.564	0.420	1.802	0.179
SPRNKLR	-0.446	0.496	0.808	0.369
FAMOWN	0.266	0.463	0.331	0.565
Q43AGE	0.000	0.014	0.000	0.987
Q9	-0.613	0.440	1.946	0.163
Q11	-0.111	0.084	1.719	0.190
OVERTEN	-0.473	0.549	0.744	0.389
Q41	0.011	0.006	2.626	0.105

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q33	1.889	0.973	3.668
OWNALL	1.831	0.814	4.120
aware	1.440	1.039	1.997
CROPS	2.328	0.881	6.154
DAIRYFM	1.510	0.373	6.108
LIVESTK	1.380	0.225	8.456
ORCHARD	1.187	0.485	2.904
FLDFRRW	1.758	0.771	4.009
SPRNKLR	0.640	0.242	1.693
FAMOWN	1.305	0.526	3.236
Q43AGE	1.000	0.974	1.027
Q9	0.541	0.229	1.282
Q11	0.895	0.759	1.056
OVERTEN	0.623	0.212	1.826
Q41	1.011	0.998	1.024

Hypothesis 9a

The REG Procedure

Dependent Variable: TTLHRDW <ttlhrdw> Variable indicating the total number of hardware changes that were implemented, with the maximum number possible being 7

Number of Observations Read	249.000
Number of Observations Used	221.000
Number of Observations with Missing Values	28.000

R-Square	0.262
Adj R-Sq	0.208
Dependent Mean	3.136
Coeff Var	47.646

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	2.866	0.680	4.210	<.0001
Q33	0.465	0.216	2.160	0.032
OWNALL	-0.254	0.248	-1.020	0.309
aware	0.079	0.090	0.880	0.378
CROPS	0.399	0.312	1.280	0.203
DAIRYFM	-0.024	0.473	-0.050	0.959
LIVESTK	-0.270	0.529	-0.510	0.610
ORCHARD	0.529	0.282	1.880	0.062
FLDFRRW	-0.915	0.273	-3.350	0.001
SPRNKLR	-0.683	0.299	-2.280	0.024
FAMOWN	0.437	0.276	1.580	0.115
Q43AGE	0.012	0.008	1.360	0.176
Q9	-1.010	0.273	-3.700	0.000
Q11	0.007	0.052	0.140	0.892
OVERTEN	0.580	0.324	1.790	0.074
Q41	0.008	0.003	2.200	0.029

Hypothesis 9b

The LOGISTIC Procedure

Response Variable	Q29BA

<q29ba> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	219.000

Probability Modeled Is Q29BA='1'.

R-Square	0.200	**Max-rescaled R-Square**	0.200

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	48.830	15.000	<.0001
Score	42.354	15.000	0.000
Wald	33.361	15.000	0.004

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-0.292	1.017	0.082	0.775
Q34	0.070	0.312	0.051	0.822
OWNALL	-0.125	0.396	0.099	0.753
aware	0.154	0.132	1.357	0.244
CROPS	-0.832	0.473	3.089	0.079
DAIRYFM	-1.893	0.875	4.679	0.031
LIVESTK	-2.234	1.120	3.976	0.046
ORCHARD	-0.061	0.412	0.022	0.883
FLDFRRW	-0.854	0.407	4.391	0.036
SPRNKLR	-0.244	0.438	0.310	0.578
FAMOWN	0.588	0.418	1.985	0.159
Q43AGE	-0.008	0.013	0.418	0.518
Q9	-0.743	0.423	3.080	0.079
Q11	0.074	0.077	0.928	0.335
OVERTEN	0.116	0.487	0.057	0.812
Q41	0.021	0.012	3.109	0.078

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q34	1.073	0.582	1.979
OWNALL	0.883	0.406	1.918
aware	1.166	0.901	1.509
CROPS	0.435	0.172	1.101
DAIRYFM	0.151	0.027	0.837
LIVESTK	0.107	0.012	0.963
ORCHARD	0.941	0.420	2.110
FLDFRRW	0.426	0.192	0.946
SPRNKLR	0.784	0.332	1.849
FAMOWN	1.801	0.794	4.082
Q43AGE	0.992	0.967	1.017
Q9	0.476	0.208	1.091
Q11	1.077	0.926	1.251
OVERTEN	1.123	0.432	2.918
Q41	1.021	0.998	1.045

Hypothesis 9b

The LOGISTIC Procedure

Response Variable	Q29CA

<q29ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	212.000

Probability Modeled Is Q29CA='1'.

R-Square	0.240	**Max-rescaled R-Square**	0.319

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	58.039	15.000	<.0001
Score	50.635	15.000	<.0001
Wald	39.454	15.000	0.001

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	2.467	1.112	4.925	0.027
Q34	0.201	0.329	0.374	0.541
OWNALL	-0.428	0.403	1.128	0.288
aware	-0.185	0.141	1.724	0.189
CROPS	0.263	0.503	0.273	0.602
DAIRYFM	0.274	0.800	0.117	0.732
LIVESTK	-1.602	1.156	1.922	0.166
ORCHARD	0.789	0.439	3.228	0.072
FLDFRRW	-1.686	0.431	15.327	<.0001
SPRNKLR	-0.914	0.465	3.862	0.049
FAMOWN	0.365	0.432	0.715	0.398
Q43AGE	0.015	0.013	1.251	0.263
Q9	-1.343	0.475	8.003	0.005
Q11	-0.086	0.082	1.101	0.294
OVERTEN	0.705	0.555	1.613	0.204
Q41	0.006	0.007	0.629	0.428

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q34	1.222	0.642	2.327
OWNALL	0.652	0.296	1.436
aware	0.831	0.630	1.096
CROPS	1.301	0.485	3.488
DAIRYFM	1.315	0.274	6.311
LIVESTK	0.201	0.021	1.941
ORCHARD	2.202	0.931	5.207
FLDFRRW	0.185	0.080	0.431
SPRNKLR	0.401	0.161	0.998
FAMOWN	1.441	0.618	3.362
Q43AGE	1.015	0.989	1.042
Q9	0.261	0.103	0.662
Q11	0.918	0.782	1.077
OVERTEN	2.024	0.682	6.007
Q41	1.006	0.992	1.020

Hypothesis 9b

The LOGISTIC Procedure

Response Variable	Q29DA

<q29da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	202.000

Probability Modeled Is Q29DA='1'.

R-Square	0.081	**Max-rescaled R-Square**	0.112

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	17.094	15.000	0.313
Score	15.994	15.000	0.382
Wald	14.686	15.000	0.474

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-2.304	1.193	3.730	0.053
Q34	0.515	0.319	2.611	0.106
OWNALL	0.104	0.391	0.070	0.791
aware	0.005	0.144	0.001	0.974
CROPS	0.783	0.504	2.414	0.120
DAIRYFM	1.419	0.715	3.935	0.047
LIVESTK	0.329	0.912	0.130	0.719
ORCHARD	1.121	0.450	6.211	0.013
FLDFRRW	-1.000	0.431	5.387	0.020
SPRNKLR	-0.611	0.455	1.806	0.179
FAMOWN	0.260	0.451	0.333	0.564
Q43AGE	0.020	0.013	2.415	0.120
Q9	0.200	0.408	0.240	0.625
Q11	-0.039	0.079	0.245	0.621
OVERTEN	0.505	0.569	0.790	0.374
Q41	0.001	0.006	0.020	0.887

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q34	1.674	0.896	3.129
OWNALL	1.109	0.515	2.388
aware	1.005	0.757	1.333
CROPS	2.189	0.815	5.881
DAIRYFM	4.131	1.017	16.779
LIVESTK	1.389	0.232	8.304
ORCHARD	3.068	1.270	7.407
FLDFRRW	0.368	0.158	0.856
SPRNKLR	0.543	0.222	1.323
FAMOWN	1.297	0.536	3.138
Q43AGE	1.020	0.995	1.046
Q9	1.221	0.549	2.718
Q11	0.962	0.824	1.123
OVERTEN	1.658	0.544	5.054
Q41	1.001	0.990	1.012

Hypothesis 9b

The LOGISTIC Procedure

Response Variable	Q29EA

<q29ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	212.000

Probability Modeled Is Q29EA='1'.

R-Square	0.131	**Max-rescaled R-Square**	0.176

Testing Global Null Hypothesis: BETA=0

Test	**Chi-Square**	**DF**	**Pr > Chi Sq**
Likelihood Ratio	29.677	15.000	0.013
Score	27.882	15.000	0.022
Wald	24.880	15.000	0.052

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-0.573	1.006	0.325	0.569
Q34	1.015	0.311	10.667	0.001
OWNALL	-0.321	0.370	0.756	0.385
aware	-0.021	0.132	0.026	0.872
CROPS	0.884	0.465	3.611	0.057
DAIRYFM	0.037	0.736	0.003	0.960
LIVESTK	0.915	0.861	1.129	0.288
ORCHARD	0.466	0.425	1.199	0.273
FLDFRRW	0.061	0.412	0.022	0.881
SPRNKLR	0.236	0.444	0.282	0.595
FAMOWN	0.536	0.415	1.672	0.196
Q43AGE	0.004	0.013	0.071	0.790
Q9	-0.996	0.437	5.204	0.023
Q11	0.091	0.080	1.322	0.250
OVERTEN	-0.243	0.466	0.271	0.602
Q41	0.002	0.005	0.208	0.649

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q34	2.758	1.500	5.071
OWNALL	0.725	0.352	1.496
aware	0.979	0.755	1.269
CROPS	2.420	0.973	6.020
DAIRYFM	1.037	0.245	4.387
LIVESTK	2.497	0.462	13.497
ORCHARD	1.593	0.692	3.666
FLDFRRW	1.063	0.475	2.383
SPRNKLR	1.266	0.530	3.025
FAMOWN	1.710	0.758	3.855
Q43AGE	1.004	0.978	1.030
Q9	0.369	0.157	0.869
Q11	1.096	0.938	1.281
OVERTEN	0.785	0.315	1.954
Q41	1.002	0.993	1.012

Hypothesis 9b

The LOGISTIC Procedure

Response Variable	Q29FA

<q29fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	201.000

Probability Modeled Is Q29FA='1'.

R-Square	0.281	**Max-rescaled R-Square**	0.375

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	66.370	12.000	<.0001
Score	57.085	12.000	<.0001
Wald	42.270	12.000	<.0001

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	2.241	1.147	3.818	0.051
Q34	0.619	0.354	3.057	0.080
OWNALL	-0.522	0.429	1.480	0.224
aware	-0.161	0.147	1.200	0.273
CROPS	0.019	0.480	0.002	0.968
FLDFRRW	-2.238	0.439	25.962	<.0001
SPRNKLR	-0.844	0.418	4.068	0.044
FAMOWN	-0.072	0.439	0.027	0.869
Q43AGE	0.006	0.014	0.204	0.652
Q9	-1.434	0.529	7.347	0.007
Q11	-0.072	0.086	0.697	0.404
OVERTEN	1.509	0.585	6.643	0.010
Q41	0.013	0.011	1.336	0.248

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q34	1.858	0.928	3.720
OWNALL	0.593	0.256	1.376
aware	0.852	0.639	1.135
CROPS	1.019	0.398	2.609
FLDFRRW	0.107	0.045	0.252
SPRNKLR	0.430	0.189	0.976
FAMOWN	0.930	0.393	2.201
Q43AGE	1.006	0.979	1.034
Q9	0.238	0.084	0.672
Q11	0.930	0.786	1.102
OVERTEN	4.520	1.435	14.234
Q41	1.013	0.991	1.035

Hypothesis 9b

The LOGISTIC Procedure

Response Variable	Q29GA

<q29ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	209.000

Probability Modeled Is Q29GA='1'.

R-Square	0.197	**Max-rescaled R-Square**	0.296

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	45.942	15.000	<.0001
Score	37.599	15.000	0.001
Wald	28.413	15.000	0.019

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-0.757	1.223	0.384	0.536
Q34	0.290	0.381	0.578	0.447
OWNALL	-0.888	0.550	2.611	0.106
aware	0.217	0.161	1.820	0.177
CROPS	0.830	0.586	2.004	0.157
DAIRYFM	1.040	0.865	1.446	0.229
LIVESTK	2.168	1.259	2.964	0.085
ORCHARD	0.823	0.517	2.535	0.111
FLDFRRW	0.120	0.521	0.053	0.819
SPRNKLR	-0.970	0.555	3.060	0.080
FAMOWN	0.232	0.528	0.193	0.660
Q43AGE	0.007	0.015	0.263	0.608
Q9	-0.937	0.482	3.781	0.052
Q11	-0.052	0.096	0.300	0.584
OVERTEN	1.564	0.530	8.713	0.003
Q41	0.065	0.027	5.714	0.017

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q34	1.336	0.633	2.819
OWNALL	0.411	0.140	1.208
aware	1.243	0.906	1.703
CROPS	2.292	0.727	7.230
DAIRYFM	2.829	0.519	15.410
LIVESTK	8.737	0.741	103.049
ORCHARD	2.276	0.827	6.265
FLDFRRW	1.127	0.406	3.130
SPRNKLR	0.379	0.128	1.124
FAMOWN	1.261	0.448	3.553
Q43AGE	1.007	0.979	1.037
Q9	0.392	0.152	1.008
Q11	0.949	0.787	1.145
OVERTEN	4.777	1.691	13.494
Q41	1.067	1.012	1.126

Hypothesis 9b

The LOGISTIC Procedure

Response Variable	Q29HA

<q29ha> Did you regularly adjust bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	202.000

Probability Modeled Is Q29HA='1'.

R-Square	0.152	**Max-rescaled R-Square**	0.209

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	33.407	15.000	0.004
Score	31.056	15.000	0.009
Wald	26.182	15.000	0.036

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-2.854	1.274	5.023	0.025
Q34	0.794	0.334	5.664	0.017
OWNALL	0.635	0.419	2.299	0.130
aware	0.354	0.167	4.475	0.034
CROPS	0.895	0.497	3.241	0.072
DAIRYFM	0.623	0.714	0.762	0.383
LIVESTK	0.487	0.930	0.275	0.600
ORCHARD	0.223	0.457	0.238	0.626
FLDFRRW	0.634	0.426	2.219	0.136
SPRNKLR	-0.308	0.493	0.392	0.531
FAMOWN	0.188	0.468	0.161	0.688
Q43AGE	0.002	0.014	0.013	0.910
Q9	-0.621	0.441	1.979	0.160
Q11	-0.092	0.084	1.220	0.269
OVERTEN	-0.517	0.547	0.895	0.344
Q41	0.011	0.006	2.714	0.100

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q34	2.213	1.150	4.255
OWNALL	1.886	0.831	4.285
aware	1.424	1.026	1.976
CROPS	2.446	0.924	6.478
DAIRYFM	1.865	0.460	7.556
LIVESTK	1.628	0.263	10.069
ORCHARD	1.250	0.510	3.062
FLDFRRW	1.885	0.819	4.341
SPRNKLR	0.735	0.280	1.929
FAMOWN	1.207	0.482	3.019
Q43AGE	1.002	0.975	1.029
Q9	0.538	0.226	1.276
Q11	0.912	0.774	1.074
OVERTEN	0.596	0.204	1.741
Q41	1.011	0.998	1.024

Hypothesis 9b

The REG Procedure

Dependent Variable: TTLHRDW <ttlhrdw> Variable indicating the total number of hardware changes that were implemented, with the maximum number possible being 7

Number of Observations	249.000
Number of Observations Used	222.000

R-Square	0.277
Adj R-Sq	0.225
Dependent Mean	3.144
Coeff Var	47.039

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	2.785	0.670	4.160	<.0001
Q34	0.594	0.205	2.890	0.004
OWNALL	-0.285	0.246	-1.160	0.248
aware	0.070	0.088	0.790	0.430
CROPS	0.466	0.305	1.530	0.128
DAIRYFM	0.134	0.466	0.290	0.775
LIVESTK	-0.160	0.525	-0.300	0.761
ORCHARD	0.585	0.277	2.110	0.036
FLDFRRW	-0.888	0.268	-3.320	0.001
SPRNKLR	-0.638	0.294	-2.170	0.031
FAMOWN	0.435	0.273	1.590	0.113
Q43AGE	0.013	0.008	1.530	0.127
Q9	-1.031	0.269	-3.830	0.000
Q11	0.013	0.051	0.260	0.797
OVERTEN	0.588	0.320	1.840	0.068
Q41	0.008	0.003	2.210	0.028

Hypothesis 10

The LOGISTIC Procedure

Response Variable	Q29BA

<q29ba> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.00
Number of Observations Used	216.00

Probability Modeled Is Q29BA='1'.

R-Square	0.22	**Max-rescaled R-Square**	0.29

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	52.60	17.00	<.0001
Score	46.59	17.00	0.00
Wald	36.34	17.00	0.00

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-1.19	1.13	1.12	0.29
PWRKGFM4	0.01	0.00	1.99	0.16
aware	0.18	0.14	1.68	0.19
OWNALL	-0.07	0.41	0.03	0.86
LARGE	0.60	0.56	1.13	0.29
MEDIUM	0.36	0.37	0.91	0.34
CROPS	-0.99	0.50	3.97	0.05
DAIRYFM	-2.33	0.93	6.24	0.01
LIVESTK	-2.44	1.15	4.53	0.03
ORCHARD	-0.21	0.43	0.24	0.63
FLDFRRW	-0.76	0.44	3.02	0.08
SPRNKLR	-0.13	0.46	0.08	0.77
FAMOWN	0.92	0.45	4.22	0.04
Q43AGE	-0.01	0.01	0.31	0.58
Q9	-0.50	0.44	1.30	0.25
Q11	0.05	0.08	0.36	0.55
OVERTEN	0.07	0.50	0.02	0.90
Q41	0.01	0.01	0.85	0.36

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	1.01	1.00	1.01
aware	1.20	0.91	1.56
OWNALL	0.93	0.42	2.07
LARGE	1.82	0.60	5.48
MEDIUM	1.43	0.69	2.98
CROPS	0.37	0.14	0.98
DAIRYFM	0.10	0.02	0.61
LIVESTK	0.09	0.01	0.83
ORCHARD	0.81	0.35	1.90
FLDFRRW	0.47	0.20	1.10
SPRNKLR	0.88	0.36	2.15
FAMOWN	2.50	1.04	6.00
Q43AGE	0.99	0.97	1.02
Q9	0.60	0.25	1.44
Q11	1.05	0.90	1.23
OVERTEN	1.07	0.40	2.86
Q41	1.01	0.99	1.04

Hypothesis 10

The LOGISTIC Procedure

Response Variable	Q29CA

<q29ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.00
Number of Observations Used	209.00

Probability Modeled Is Q29CA='1'.

R-Square	0.25	**Max-rescaled R-Square**	0.34

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	60.99	17.00	<.0001
Score	52.72	17.00	<.0001
Wald	40.17	17.00	0.00

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	2.694	1.208	4.977	0.026
PWRKGFM4	-0.006	0.004	2.112	0.146
aware	-0.121	0.143	0.721	0.396
OWNALL	-0.612	0.422	2.099	0.147
LARGE	0.365	0.537	0.463	0.496
MEDIUM	-0.127	0.389	0.107	0.744
CROPS	0.429	0.519	0.682	0.409
DAIRYFM	0.603	0.858	0.494	0.482
LIVESTK	-1.532	1.155	1.759	0.185
ORCHARD	0.988	0.461	4.593	0.032
FLDFRRW	-1.935	0.464	17.421	<.0001
SPRNKLR	-1.056	0.487	4.701	0.030
FAMOWN	0.440	0.455	0.935	0.334
Q43AGE	0.011	0.014	0.619	0.431
Q9	-1.557	0.507	9.453	0.002
Q11	-0.059	0.086	0.468	0.494
OVERTEN	0.712	0.559	1.622	0.203
Q41	0.006	0.008	0.536	0.464

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	0.994	0.986	1.002
aware	0.886	0.670	1.172
OWNALL	0.542	0.237	1.241
LARGE	1.441	0.503	4.129
MEDIUM	0.881	0.411	1.887
CROPS	1.535	0.555	4.246
DAIRYFM	1.828	0.340	9.831
LIVESTK	0.216	0.022	2.079
ORCHARD	2.685	1.088	6.624
FLDFRRW	0.145	0.058	0.358
SPRNKLR	0.348	0.134	0.904
FAMOWN	1.552	0.637	3.784
Q43AGE	1.011	0.984	1.039
Q9	0.211	0.078	0.569
Q11	0.943	0.796	1.116
OVERTEN	2.038	0.681	6.094
Q41	1.006	0.991	1.021

Hypothesis 10

The LOGISTIC Procedure

Response Variable	Q29DA

<q29da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	199.000

Probability Modeled Is Q29DA='1'.

R-Square	0.088	**Max-rescaled R-Square**	0.122

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	18.405	17.000	0.364
Score	17.092	17.000	0.448
Wald	15.587	17.000	0.553

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-2.299	1.302	3.115	0.078
PWRKGFM4	0.003	0.004	0.516	0.473
aware	0.083	0.151	0.299	0.584
OWNALL	-0.005	0.410	0.000	0.991
LARGE	-0.551	0.520	1.122	0.289
MEDIUM	-0.309	0.385	0.646	0.422
CROPS	0.890	0.527	2.850	0.091
DAIRYFM	1.723	0.784	4.828	0.028
LIVESTK	0.492	0.926	0.282	0.596
ORCHARD	1.288	0.474	7.385	0.007
FLDFRRW	-1.020	0.459	4.937	0.026
SPRNKLR	-0.711	0.474	2.248	0.134
FAMOWN	0.332	0.495	0.451	0.502
Q43AGE	0.019	0.013	1.939	0.164
Q9	0.127	0.429	0.088	0.767
Q11	-0.051	0.083	0.374	0.541
OVERTEN	0.420	0.569	0.545	0.460
Q41	0.002	0.007	0.094	0.760

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	1.003	0.995	1.011
aware	1.086	0.808	1.461
OWNALL	0.996	0.446	2.222
LARGE	0.576	0.208	1.598
MEDIUM	0.734	0.345	1.560
CROPS	2.435	0.867	6.840
DAIRYFM	5.600	1.205	26.038
LIVESTK	1.635	0.266	10.039
ORCHARD	3.624	1.432	9.173
FLDFRRW	0.361	0.147	0.887
SPRNKLR	0.491	0.194	1.244
FAMOWN	1.394	0.528	3.681
Q43AGE	1.019	0.992	1.046
Q9	1.136	0.490	2.631
Q11	0.950	0.808	1.118
OVERTEN	1.522	0.499	4.637
Q41	1.002	0.989	1.015

Hypothesis 10

The LOGISTIC Procedure

Response Variable	Q29EA

<q29ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	209.000

Probability Modeled Is Q29EA='1'.

R-Square	0.118	**Max-rescaled R-Square**	0.159

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	26.278	17.000	0.070
Score	24.407	17.000	0.109
Wald	21.794	17.000	0.193

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-0.145	1.082	0.018	0.894
PWRKGFM4	0.002	0.004	0.165	0.685
aware	0.041	0.133	0.095	0.758
OWNALL	-0.236	0.378	0.390	0.532
LARGE	-1.423	0.537	7.012	0.008
MEDIUM	0.015	0.356	0.002	0.966
CROPS	0.984	0.472	4.343	0.037
DAIRYFM	0.271	0.781	0.120	0.729
LIVESTK	1.008	0.845	1.423	0.233
ORCHARD	0.613	0.433	1.999	0.157
FLDFRRW	0.114	0.423	0.072	0.788
SPRNKLR	0.170	0.453	0.140	0.708
FAMOWN	0.272	0.439	0.383	0.536
Q43AGE	0.000	0.013	0.001	0.979
Q9	-1.009	0.447	5.109	0.024
Q11	0.101	0.082	1.512	0.219
OVERTEN	-0.363	0.474	0.588	0.443
Q41	0.010	0.006	2.992	0.084

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	1.001	0.994	1.009
aware	1.042	0.803	1.352
OWNALL	0.790	0.377	1.656
LARGE	0.241	0.084	0.691
MEDIUM	1.015	0.505	2.040
CROPS	2.675	1.060	6.751
DAIRYFM	1.311	0.284	6.060
LIVESTK	2.739	0.523	14.341
ORCHARD	1.845	0.789	4.313
FLDFRRW	1.121	0.489	2.567
SPRNKLR	1.185	0.488	2.877
FAMOWN	1.312	0.555	3.103
Q43AGE	1.000	0.975	1.026
Q9	0.365	0.152	0.875
Q11	1.106	0.942	1.298
OVERTEN	0.695	0.275	1.760
Q41	1.010	0.999	1.021

Hypothesis 10

The LOGISTIC Procedure

Response Variable	Q29FA

<Q29FA> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	198.000

Probability Modeled Is Q29FA='1'.

R-Square	0.275	**Max-rescaled R-Square**	0.367

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	63.742	14.000	<.0001
Score	55.049	14.000	<.0001
Wald	41.014	14.000	0.000

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	2.452	1.207	4.127	0.042
PWRKGFM4	-0.002	0.004	0.158	0.691
aware	-0.045	0.144	0.097	0.755
OWNALL	-0.612	0.440	1.937	0.164
LARGE	0.036	0.572	0.004	0.949
MEDIUM	-0.121	0.401	0.090	0.764
CROPS	0.044	0.483	0.008	0.927
FLDFRRW	-2.273	0.455	24.922	<.0001
SPRNKLR	-0.827	0.422	3.838	0.050
FAMOWN	-0.043	0.450	0.009	0.924
Q43AGE	0.001	0.015	0.010	0.922
Q9	-1.637	0.571	8.207	0.004
Q11	-0.065	0.089	0.528	0.467
OVERTEN	1.364	0.570	5.717	0.017
Q41	0.011	0.012	0.860	0.354

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	0.998	0.990	1.007
aware	0.956	0.722	1.267
OWNALL	0.542	0.229	1.284
LARGE	1.037	0.338	3.184
MEDIUM	0.887	0.404	1.946
CROPS	1.045	0.405	2.695
FLDFRRW	0.103	0.042	0.251
SPRNKLR	0.437	0.191	1.000
FAMOWN	0.958	0.397	2.314
Q43AGE	1.001	0.973	1.030
Q9	0.195	0.063	0.596
Q11	0.937	0.787	1.116
OVERTEN	3.910	1.279	11.956
Q41	1.011	0.988	1.035

Hypothesis 10

The LOGISTIC Procedure

Response Variable	Q29GA

<q29ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249
Number of Observations Used	206

Probability Modeled Is Q29GA='1'.

R-Square	0.2086	**Max-rescaled R-Square**	0.3131

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	48.198	17.000	<.0001
Score	37.018	17.000	0.003
Wald	27.936	17.000	0.046

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-1.269	1.362	0.867	0.352
PWRKGFM4	-0.004	0.005	0.760	0.383
aware	0.268	0.168	2.538	0.111
OWNALL	-0.796	0.568	1.967	0.161
LARGE	-0.532	0.688	0.598	0.440
MEDIUM	0.401	0.473	0.719	0.396
CROPS	0.890	0.608	2.140	0.144
DAIRYFM	0.998	0.926	1.163	0.281
LIVESTK	2.237	1.242	3.245	0.072
ORCHARD	0.935	0.536	3.041	0.081
FLDFRRW	-0.184	0.566	0.105	0.746
SPRNKLR	-1.073	0.581	3.406	0.065
FAMOWN	0.242	0.565	0.184	0.668
Q43AGE	0.005	0.015	0.127	0.722
Q9	-0.738	0.511	2.087	0.149
Q11	-0.026	0.101	0.069	0.793
OVERTEN	1.432	0.541	7.010	0.008
Q41	0.096	0.036	7.056	0.008

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	0.996	0.986	1.005
aware	1.308	0.940	1.819
OWNALL	0.451	0.148	1.372
LARGE	0.588	0.153	2.262
MEDIUM	1.493	0.591	3.770
CROPS	2.434	0.739	8.015
DAIRYFM	2.714	0.442	16.654
LIVESTK	9.363	0.821	106.739
ORCHARD	2.546	0.891	7.279
FLDFRRW	0.832	0.275	2.522
SPRNKLR	0.342	0.109	1.069
FAMOWN	1.274	0.421	3.853
Q43AGE	1.005	0.976	1.036
Q9	0.478	0.176	1.301
Q11	0.974	0.800	1.186
OVERTEN	4.188	1.451	12.093
Q41	1.101	1.026	1.182

Hypothesis 10

The LOGISTIC Procedure

Response Variable	Q29HA

<q29ha> Did you regularly adjust bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	199.000

Probability Modeled Is Q29HA='1'.

R-Square	0.153	**Max-rescaled R-Square**	0.210

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > Chi Sq
Likelihood Ratio	33.051	17.000	0.011
Score	30.806	17.000	0.021
Wald	25.974	17.000	0.075

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-3.829	1.393	7.553	0.006
PWRKGFM4	0.001	0.004	0.057	0.812
aware	0.473	0.169	7.881	0.005
OWNALL	0.935	0.439	4.547	0.033
LARGE	0.254	0.543	0.219	0.640
MEDIUM	0.884	0.407	4.719	0.030
CROPS	0.973	0.513	3.598	0.058
DAIRYFM	-0.116	0.777	0.022	0.882
LIVESTK	0.297	0.934	0.101	0.750
ORCHARD	0.126	0.468	0.072	0.788
FLDFRRW	0.796	0.452	3.102	0.078
SPRNKLR	-0.075	0.504	0.022	0.882
FAMOWN	0.262	0.494	0.283	0.595
Q43AGE	-0.005	0.014	0.112	0.738
Q9	-0.584	0.456	1.637	0.201
Q11	-0.089	0.090	0.991	0.319
OVERTEN	-0.656	0.557	1.390	0.238
Q41	0.012	0.007	3.029	0.082

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
PWRKGFM4	1.001	0.993	1.009
aware	1.605	1.153	2.233
OWNALL	2.547	1.079	6.016
LARGE	1.290	0.445	3.739
MEDIUM	2.420	1.090	5.370
CROPS	2.645	0.968	7.228
DAIRYFM	0.891	0.194	4.083
LIVESTK	1.346	0.216	8.392
ORCHARD	1.134	0.453	2.840
FLDFRRW	2.216	0.914	5.372
SPRNKLR	0.928	0.345	2.493
FAMOWN	1.300	0.494	3.420
Q43AGE	0.995	0.969	1.022
Q9	0.558	0.228	1.364
Q11	0.914	0.767	1.090
OVERTEN	0.519	0.174	1.545
Q41	1.012	0.999	1.026

Hypothesis 10

The REG Procedure
Dependent Variable: total

Number of Observations Read	249.000
Number of Observations Used	218.000

R-Square	0.355
Adj R-Sq	0.267
Dependent Mean	6.367
Coeff Var	38.550

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	5.563	0.957	5.810	<.0001
PWRKGFM4	0.011	0.017	0.650	0.514
Q4	0.054	0.124	0.440	0.663
LARGE	-0.567	0.951	-0.600	0.552
MEDIUM	0.337	0.532	0.630	0.527
CROPS	-0.160	0.725	-0.220	0.825
DAIRYFM	-2.850	1.334	-2.140	0.034
LIVESTK	-1.294	1.057	-1.220	0.222
ORCHARD	1.164	0.659	1.770	0.079
FLDFRRW	-2.563	0.629	-4.070	<.0001
SPRNKLR	-0.861	0.770	-1.120	0.264
FAMOWN	0.723	0.484	1.500	0.136
Q43AGE	0.010	0.017	0.580	0.563
large_fm	0.017	0.012	1.470	0.144
ownall_fm	-0.011	0.006	-1.950	0.052
medium_fm	0.012	0.008	1.460	0.146
crops_fm	0.010	0.011	0.910	0.363
dairy_fm	0.029	0.018	1.650	0.101
livestk_fm	-0.005	0.019	-0.250	0.805
orchard_fm	-0.003	0.010	-0.340	0.738
fldfrrw_fm	0.012	0.010	1.160	0.247
sprinklr_fm	-0.001	0.010	-0.070	0.948
q43age_fm	0.000	0.000	-0.500	0.616
q9_fm	-0.012	0.008	-1.410	0.161
q11_fm	0.000	0.001	0.030	0.977
q41_fm	0.000	0.000	1.590	0.114
overten_fm	0.007	0.008	0.890	0.373

Hypothesis 11a

The LOGISTIC Procedure

Response Variable	Q29BA

<q29ba> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	226.000

Probability Modeled Is Q29BA='1'.

R-Square	0.191	**Max-rescaled R-Square**	0.255

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	47.845	13.000	<.0001
Score	40.867	13.000	0.000
Wald	32.821	13.000	0.002

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	0.080	0.982	0.007	0.935
Q3	0.008	0.108	0.006	0.938
OWNALL	0.149	0.378	0.156	0.693
CROPS	-0.706	0.452	2.438	0.119
DAIRYFM	-1.804	0.866	4.346	0.037
LIVESTK	-2.198	1.118	3.863	0.049
ORCHARD	-0.058	0.396	0.021	0.884
FLDFRRW	-0.853	0.394	4.673	0.031
SPRNKLR	-0.212	0.422	0.252	0.616
FAMOWN	0.689	0.407	2.872	0.090
Q9	-0.772	0.400	3.726	0.054
Q11	0.075	0.074	1.035	0.309
OVERTEN	0.121	0.449	0.072	0.789
Q41	0.024	0.012	3.887	0.049

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	1.008	0.817	1.245
OWNALL	1.161	0.553	2.437
CROPS	0.494	0.204	1.197
DAIRYFM	0.165	0.030	0.898
LIVESTK	0.111	0.012	0.994
ORCHARD	0.944	0.434	2.052
FLDFRRW	0.426	0.197	0.924
SPRNKLR	0.809	0.354	1.850
FAMOWN	1.992	0.898	4.418
Q9	0.462	0.211	1.012
Q11	1.078	0.933	1.246
OVERTEN	1.128	0.468	2.721
Q41	1.024	1.000	1.048

Hypothesis 11a

The LOGISTIC Procedure

Response Variable	Q29CA

<q29ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	219.000

Probability Modeled Is Q29CA='1'.

R-Square	0.221	**Max-rescaled R-Square**	0.294

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	54.549	13.000	<.0001
Score	48.419	13.000	<.0001
Wald	38.762	13.000	0.000

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	2.488	1.076	5.346	0.021
Q3	-0.144	0.116	1.534	0.216
OWNALL	-0.334	0.385	0.756	0.385
CROPS	0.279	0.478	0.341	0.559
DAIRYFM	0.059	0.780	0.006	0.940
LIVESTK	-1.731	1.152	2.260	0.133
ORCHARD	0.747	0.422	3.130	0.077
FLDFRRW	-1.679	0.413	16.504	<.0001
SPRNKLR	-0.864	0.445	3.771	0.052
FAMOWN	0.468	0.417	1.259	0.262
Q9	-1.112	0.425	6.837	0.009
Q11	-0.094	0.078	1.442	0.230
OVERTEN	0.437	0.497	0.773	0.379
Q41	0.006	0.007	0.677	0.411

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	0.866	0.689	1.087
OWNALL	0.716	0.337	1.521
CROPS	1.322	0.518	3.371
DAIRYFM	1.060	0.230	4.892
LIVESTK	0.177	0.019	1.692
ORCHARD	2.110	0.923	4.825
FLDFRRW	0.187	0.083	0.419
SPRNKLR	0.422	0.176	1.008
FAMOWN	1.597	0.705	3.616
Q9	0.329	0.143	0.757
Q11	0.911	0.782	1.061
OVERTEN	1.548	0.585	4.100
Q41	1.006	0.992	1.020

Hypothesis 11a

The LOGISTIC Procedure

Response Variable	Q29DA

<q29da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	208.000

Probability Modeled Is Q29DA='1'.

R-Square	0.060	**Max-rescaled R-Square**	0.083

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	12.812	13.000	0.463
Score	12.070	13.000	0.522
Wald	11.325	13.000	0.584

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-2.035	1.125	3.268	0.071
Q3	0.089	0.121	0.550	0.458
OWNALL	0.183	0.378	0.235	0.628
CROPS	0.899	0.485	3.433	0.064
DAIRYFM	1.249	0.689	3.287	0.070
LIVESTK	0.354	0.894	0.157	0.692
ORCHARD	1.012	0.426	5.638	0.018
FLDFRRW	-0.808	0.415	3.783	0.052
SPRNKLR	-0.528	0.440	1.440	0.230
FAMOWN	0.326	0.445	0.535	0.465
Q9	-0.091	0.386	0.055	0.815
Q11	-0.045	0.075	0.357	0.551
OVERTEN	0.537	0.512	1.100	0.294
Q41	0.001	0.006	0.053	0.817

Odds Ratio Estimates

Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Q3	1.093	0.863	1.385
OWNALL	1.201	0.573	2.518
CROPS	2.457	0.949	6.357
DAIRYFM	3.488	0.904	13.460
LIVESTK	1.425	0.247	8.218
ORCHARD	2.751	1.193	6.345
FLDFRRW	0.446	0.197	1.006
SPRNKLR	0.590	0.249	1.397
FAMOWN	1.385	0.579	3.316
Q9	0.913	0.428	1.947
Q11	0.956	0.825	1.108
OVERTEN	1.710	0.627	4.663
Q41	1.001	0.990	1.013

Hypothesis 11a

The LOGISTIC Procedure

Response Variable	Q29EA

<q29ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	217.000

Probability Modeled Is Q29EA='1'.

R-Square	0.099	**Max-rescaled R-Square**	0.134

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	22.724	13.000	0.045
Score	21.458	13.000	0.064
Wald	19.501	13.000	0.108

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-0.458	0.959	0.228	0.633
Q3	0.039	0.110	0.124	0.725
OWNALL	-0.312	0.356	0.768	0.381
CROPS	0.985	0.444	4.930	0.026
DAIRYFM	-0.139	0.719	0.038	0.847
LIVESTK	0.834	0.815	1.049	0.306
ORCHARD	0.561	0.405	1.915	0.166
FLDFRRW	0.197	0.389	0.255	0.613
SPRNKLR	0.171	0.431	0.158	0.691
FAMOWN	0.564	0.405	1.947	0.163
Q9	-1.130	0.407	7.708	0.006
Q11	0.111	0.076	2.149	0.143
OVERTEN	-0.144	0.440	0.107	0.744
Q41	0.003	0.005	0.427	0.514

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	1.039	0.839	1.288
OWNALL	0.732	0.364	1.471
CROPS	2.677	1.122	6.385
DAIRYFM	0.870	0.212	3.564
LIVESTK	2.303	0.467	11.370
ORCHARD	1.752	0.792	3.876
FLDFRRW	1.217	0.568	2.611
SPRNKLR	1.187	0.510	2.760
FAMOWN	1.758	0.796	3.885
Q9	0.323	0.145	0.717
Q11	1.118	0.963	1.297
OVERTEN	0.866	0.366	2.052
Q41	1.003	0.994	1.013

Hypothesis 11a

The LOGISTIC Procedure

Response Variable	Q29FA

<q29fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	208.000

Probability Modeled Is Q29FA='1'.

R-Square	0.269	**Max-rescaled R-Square**	0.359

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**	
Likelihood Ratio	65.121	10.000	<.0001	
Score	56.612	10.000	<.0001	
Wald	42.688	10.000	<.0001	

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	2.078	1.096	3.594	0.058
Q3	0.020	0.120	0.028	0.867
OWNALL	-0.411	0.408	1.012	0.315
CROPS	0.291	0.452	0.414	0.520
FLDFRRW	-2.037	0.418	23.754	<.0001
SPRNKLR	-0.724	0.402	3.246	0.072
FAMOWN	-0.129	0.425	0.092	0.761
Q9	-1.771	0.514	11.881	0.001
Q11	-0.057	0.083	0.465	0.496
OVERTEN	1.205	0.525	5.262	0.022
Q41	0.011	0.011	1.033	0.310

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	1.020	0.806	1.291
OWNALL	0.663	0.298	1.476
CROPS	1.337	0.552	3.240
FLDFRRW	0.130	0.057	0.296
SPRNKLR	0.485	0.220	1.066
FAMOWN	0.879	0.382	2.023
Q9	0.170	0.062	0.466
Q11	0.945	0.803	1.112
OVERTEN	3.336	1.192	9.341
Q41	1.011	0.990	1.032

Hypothesis 11a

The LOGISTIC Procedure

Response Variable	Q29GA

<q29ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	216.000

Probability Modeled Is Q29GA='1'.

R-Square	0.192	**Max-rescaled R-Square**	0.289

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	46.099	13.000	<.0001
Score	37.452	13.000	0.000
Wald	27.741	13.000	0.010

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-1.303	1.228	1.125	0.289
Q3	0.315	0.134	5.503	0.019
OWNALL	-0.864	0.527	2.693	0.101
CROPS	0.859	0.576	2.221	0.136
DAIRYFM	0.711	0.842	0.712	0.399
LIVESTK	2.189	1.256	3.039	0.081
ORCHARD	0.803	0.499	2.590	0.108
FLDFRRW	0.160	0.503	0.101	0.751
SPRNKLR	-0.828	0.543	2.324	0.127
FAMOWN	0.382	0.515	0.550	0.458
Q9	-0.713	0.466	2.348	0.126
Q11	-0.051	0.091	0.309	0.578
OVERTEN	1.302	0.501	6.751	0.009
Q41	0.071	0.028	6.334	0.012

Odds Ratio Estimates

Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Q3	1.370	1.053	1.783
OWNALL	0.421	0.150	1.183
CROPS	2.361	0.763	7.306
DAIRYFM	2.035	0.391	10.606
LIVESTK	8.924	0.762	104.528
ORCHARD	2.233	0.839	5.938
FLDFRRW	1.173	0.438	3.145
SPRNKLR	0.437	0.151	1.267
FAMOWN	1.465	0.534	4.020
Q9	0.490	0.197	1.220
Q11	0.951	0.795	1.137
OVERTEN	3.677	1.377	9.820
Q41	1.073	1.016	1.134

Hypothesis 11a

The LOGISTIC Procedure

Response Variable	Q29HA

<q29ha> Did you regularly adjust bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	209.000

Probability Modeled Is Q29HA='1'.

R-Square	0.136	**Max-rescaled R-Square**	0.186

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	30.462	13.000	0.004
Score	28.740	13.000	0.007
Wald	24.685	13.000	0.025

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-2.701	1.207	5.004	0.025
Q3	0.363	0.142	6.525	0.011
OWNALL	0.673	0.402	2.795	0.095
CROPS	0.865	0.474	3.336	0.068
DAIRYFM	0.373	0.693	0.291	0.590
LIVESTK	0.442	0.902	0.240	0.624
ORCHARD	0.337	0.434	0.603	0.437
FLDFRRW	0.783	0.407	3.697	0.055
SPRNKLR	-0.298	0.469	0.405	0.524
FAMOWN	0.340	0.451	0.568	0.451
Q9	-0.647	0.413	2.462	0.117
Q11	-0.099	0.079	1.557	0.212
OVERTEN	-0.476	0.505	0.887	0.346
Q41	0.012	0.006	3.345	0.067

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q3	1.437	1.088	1.899
OWNALL	1.960	0.891	4.312
CROPS	2.375	0.939	6.011
DAIRYFM	1.453	0.374	5.645
LIVESTK	1.556	0.265	9.116
ORCHARD	1.401	0.599	3.278
FLDFRRW	2.188	0.985	4.858
SPRNKLR	0.742	0.296	1.859
FAMOWN	1.405	0.580	3.403
Q9	0.523	0.233	1.175
Q11	0.906	0.776	1.058
OVERTEN	0.621	0.231	1.673
Q41	1.012	0.999	1.025

Hypothesis 11a

The REG Procedure

Dependent Variable: TTLHRDW <ttlhrdw> Variable indicating the total number of hardware changes that were implemented, with the maximum number possible being 7

Number of Observations Read	249.000
Number of Observations Used	232.000

R-Square	0.233
Adj R-Sq	0.191
Dependent Mean	3.112
Coeff Var	48.285

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	3.471	0.561	6.190	<.0001
OWNALL	-0.097	0.240	-0.400	0.687
CROPS	0.554	0.301	1.840	0.067
DAIRYFM	0.040	0.467	0.080	0.933
LIVESTK	-0.219	0.529	-0.410	0.680
ORCHARD	0.612	0.272	2.250	0.026
FLDFRRW	-0.832	0.262	-3.170	0.002
SPRNKLR	-0.554	0.290	-1.910	0.058
FAMOWN	0.500	0.272	1.840	0.067
Q9	-1.057	0.257	-4.120	<.0001
Q11	0.014	0.049	0.280	0.782
OVERTEN	0.576	0.302	1.910	0.058
Q41	0.009	0.003	2.530	0.012

Hypothesis 11b

The LOGISTIC Procedure

Response Variable	Q29BA

<q29ba> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	227.000

Probability Modeled Is Q29BA='1'.

R-Square	0.202	**Max-rescaled R-Square**	0.269

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	51.228	13.000	<.0001
Score	44.399	13.000	<.0001
Wald	35.040	13.000	0.001

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-0.509	0.927	0.301	0.583
Q4	0.204	0.105	3.763	0.052
OWNALL	0.004	0.382	0.000	0.992
CROPS	-0.788	0.460	2.943	0.086
DAIRYFM	-1.863	0.870	4.582	0.032
LIVESTK	-2.324	1.119	4.316	0.038
ORCHARD	-0.068	0.402	0.028	0.867
FLDFRRW	-0.854	0.398	4.608	0.032
SPRNKLR	-0.264	0.426	0.383	0.536
FAMOWN	0.590	0.413	2.046	0.153
Q9	-0.887	0.403	4.843	0.028
Q11	0.074	0.074	1.004	0.316
OVERTEN	-0.008	0.458	0.000	0.986
Q41	0.022	0.012	3.193	0.074

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q4	1.226	0.998	1.507
OWNALL	1.004	0.474	2.124
CROPS	0.455	0.185	1.119
DAIRYFM	0.155	0.028	0.855
LIVESTK	0.098	0.011	0.877
ORCHARD	0.935	0.425	2.055
FLDFRRW	0.426	0.195	0.928
SPRNKLR	0.768	0.333	1.772
FAMOWN	1.804	0.804	4.049
Q9	0.412	0.187	0.908
Q11	1.076	0.932	1.243
OVERTEN	0.992	0.404	2.434
Q41	1.022	0.998	1.046

Hypothesis 11b

The LOGISTIC Procedure

Response Variable	Q29CA

<q29ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	220.000

Probability Modeled Is Q29CA='1'.

R-Square	0.220	**Max-rescaled R-Square**	0.293

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	54.647	13.000	<.0001
Score	48.572	13.000	<.0001
Wald	38.958	13.000	0.000

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	2.291	0.976	5.510	0.019
Q4	-0.122	0.108	1.276	0.259
OWNALL	-0.342	0.385	0.791	0.374
CROPS	0.296	0.481	0.378	0.539
DAIRYFM	0.061	0.778	0.006	0.938
LIVESTK	-1.560	1.147	1.848	0.174
ORCHARD	0.799	0.424	3.555	0.059
FLDFRRW	-1.647	0.412	16.011	<.0001
SPRNKLR	-0.903	0.443	4.156	0.042
FAMOWN	0.488	0.422	1.341	0.247
Q9	-1.061	0.425	6.239	0.013
Q11	-0.110	0.077	2.043	0.153
OVERTEN	0.433	0.499	0.750	0.386
Q41	0.007	0.007	0.865	0.352

Odds Ratio Estimates

Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Q4	0.885	0.716	1.094
OWNALL	0.710	0.334	1.510
CROPS	1.344	0.524	3.447
DAIRYFM	1.063	0.231	4.880
LIVESTK	0.210	0.022	1.992
ORCHARD	2.223	0.969	5.101
FLDFRRW	0.193	0.086	0.432
SPRNKLR	0.405	0.170	0.966
FAMOWN	1.629	0.713	3.723
Q9	0.346	0.151	0.796
Q11	0.896	0.770	1.042
OVERTEN	1.541	0.579	4.101
Q41	1.007	0.992	1.022

Hypothesis 11b

The LOGISTIC Procedure

Response Variable	Q29DA

<q29da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	209.000

Probability Modeled Is Q29DA='1'.

R-Square	0.058	**Max-rescaled R-Square**	0.081

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	12.486	13.000	0.488
Score	11.718	13.000	0.551
Wald	11.011	13.000	0.610

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-1.792	1.067	2.823	0.093
Q4	0.033	0.114	0.085	0.771
OWNALL	0.205	0.380	0.291	0.590
CROPS	0.970	0.492	3.890	0.049
DAIRYFM	1.353	0.692	3.822	0.051
LIVESTK	0.372	0.903	0.170	0.680
ORCHARD	1.037	0.436	5.657	0.017
FLDFRRW	-0.859	0.414	4.295	0.038
SPRNKLR	-0.486	0.441	1.219	0.270
FAMOWN	0.290	0.446	0.421	0.516
Q9	-0.050	0.387	0.017	0.897
Q11	-0.040	0.075	0.283	0.595
OVERTEN	0.513	0.514	0.997	0.318
Q41	0.002	0.006	0.078	0.780

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q4	1.034	0.828	1.291
OWNALL	1.227	0.583	2.586
CROPS	2.637	1.006	6.912
DAIRYFM	3.867	0.997	15.008
LIVESTK	1.451	0.247	8.513
ORCHARD	2.820	1.200	6.626
FLDFRRW	0.424	0.188	0.954
SPRNKLR	0.615	0.259	1.458
FAMOWN	1.336	0.557	3.205
Q9	0.951	0.445	2.032
Q11	0.961	0.830	1.113
OVERTEN	1.670	0.610	4.569
Q41	1.002	0.990	1.013

Hypothesis 11b

The LOGISTIC Procedure

Response Variable	Q29EA

<q29ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	218.000

Probability Modeled Is Q29EA='1'.

R-Square	0.095	**Max-rescaled R-Square**	0.128

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	21.766	13.000	0.059
Score	20.616	13.000	0.081
Wald	18.779	13.000	0.130

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	-0.464	0.890	0.272	0.602
Q4	0.047	0.101	0.213	0.645
OWNALL	-0.275	0.355	0.598	0.439
CROPS	0.978	0.445	4.845	0.028
DAIRYFM	-0.112	0.718	0.025	0.876
LIVESTK	0.779	0.815	0.912	0.340
ORCHARD	0.468	0.406	1.329	0.249
FLDFRRW	0.097	0.387	0.062	0.803
SPRNKLR	0.194	0.428	0.206	0.650
FAMOWN	0.540	0.406	1.768	0.184
Q9	-1.107	0.406	7.434	0.006
Q11	0.113	0.074	2.287	0.131
OVERTEN	-0.165	0.442	0.140	0.709
Q41	0.003	0.005	0.363	0.547

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q4	1.048	0.859	1.277
OWNALL	0.760	0.379	1.524
CROPS	2.660	1.113	6.358
DAIRYFM	0.894	0.219	3.648
LIVESTK	2.179	0.441	10.766
ORCHARD	1.597	0.721	3.539
FLDFRRW	1.101	0.516	2.352
SPRNKLR	1.214	0.525	2.811
FAMOWN	1.717	0.774	3.807
Q9	0.330	0.149	0.732
Q11	1.119	0.967	1.295
OVERTEN	0.848	0.356	2.017
Q41	1.003	0.994	1.012

Hypothesis 11b

The LOGISTIC Procedure

Response Variable	Q29FA

<q29fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	209.000

Probability Modeled Is Q29FA='1'.

R-Square	0.273	**Max-rescaled R-Square**	0.364

Testing Global Null Hypothesis: BETA=0

Test	**Chi-Square**	**DF**	**Pr > Chi Sq**
Likelihood Ratio	66.621	10.000	<.0001
Score	57.727	10.000	<.0001
Wald	43.749	10.000	<.0001

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	2.511	1.037	5.861	0.016
Q4	-0.124	0.114	1.181	0.277
OWNALL	-0.306	0.410	0.559	0.455
CROPS	0.346	0.452	0.587	0.444
FLDFRRW	-2.050	0.419	23.975	<.0001
SPRNKLR	-0.644	0.398	2.608	0.106
FAMOWN	-0.083	0.432	0.037	0.848
Q9	-1.710	0.513	11.100	0.001
Q11	-0.048	0.082	0.342	0.559
OVERTEN	1.300	0.532	5.967	0.015
Q41	0.012	0.011	1.289	0.256

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q4	0.884	0.707	1.104
OWNALL	0.736	0.330	1.643
CROPS	1.414	0.583	3.426
FLDFRRW	0.129	0.057	0.293
SPRNKLR	0.525	0.241	1.147
FAMOWN	0.921	0.395	2.145
Q9	0.181	0.066	0.495
Q11	0.953	0.812	1.119
OVERTEN	3.671	1.293	10.420
Q41	1.012	0.991	1.034

Hypothesis 11b

The LOGISTIC Procedure

Response Variable	Q29GA

<q29ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	217.000

Probability Modeled Is Q29GA='1'.

R-Square	0.174	**Max-rescaled R-Square**	0.262

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	41.489	13.000	<.0001
Score	33.600	13.000	0.001
Wald	26.918	13.000	0.013

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	0.244	1.114	0.048	0.827
Q4	-0.041	0.124	0.108	0.743
OWNALL	-0.716	0.518	1.914	0.167
CROPS	0.892	0.562	2.519	0.113
DAIRYFM	0.853	0.838	1.036	0.309
LIVESTK	1.900	1.187	2.564	0.109
ORCHARD	0.898	0.490	3.355	0.067
FLDFRRW	0.261	0.493	0.281	0.596
SPRNKLR	-0.614	0.519	1.398	0.237
FAMOWN	0.424	0.508	0.698	0.403
Q9	-0.686	0.457	2.250	0.134
Q11	-0.023	0.088	0.068	0.795
OVERTEN	1.436	0.482	8.868	0.003
Q41	0.066	0.027	6.055	0.014

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q4	0.960	0.753	1.225
OWNALL	0.489	0.177	1.348
CROPS	2.440	0.811	7.341
DAIRYFM	2.346	0.454	12.124
LIVESTK	6.685	0.653	68.399
ORCHARD	2.455	0.939	6.420
FLDFRRW	1.299	0.494	3.415
SPRNKLR	0.541	0.196	1.497
FAMOWN	1.529	0.565	4.136
Q9	0.504	0.205	1.234
Q11	0.977	0.822	1.162
OVERTEN	4.205	1.634	10.824
Q41	1.068	1.013	1.126

Hypothesis 11b

The LOGISTIC Procedure

Response Variable	Q29HA

<q29ha> Did you regularly adjust bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	210.000

Probability Modeled Is Q29HA='1'.

R-Square	0.124	**Max-rescaled R-Square**	0.170

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	27.748	13.000	0.010
Score	26.323	13.000	0.015
Wald	22.997	13.000	0.042

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-1.921	1.051	3.340	0.068
Q4	0.265	0.125	4.501	0.034
OWNALL	0.682	0.402	2.886	0.089
CROPS	0.869	0.473	3.373	0.066
DAIRYFM	0.519	0.695	0.557	0.455
LIVESTK	0.213	0.903	0.056	0.813
ORCHARD	0.269	0.435	0.381	0.537
FLDFRRW	0.686	0.402	2.912	0.088
SPRNKLR	-0.158	0.468	0.113	0.737
FAMOWN	0.251	0.453	0.306	0.580
Q9	-0.681	0.411	2.744	0.098
Q11	-0.079	0.077	1.060	0.303
OVERTEN	-0.627	0.503	1.558	0.212
Q41	0.011	0.006	3.379	0.066

Odds Ratio Estimates

Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Q4	1.303	1.020	1.664
OWNALL	1.978	0.900	4.346
CROPS	2.385	0.943	6.028
DAIRYFM	1.680	0.430	6.558
LIVESTK	1.238	0.211	7.268
ORCHARD	1.308	0.558	3.069
FLDFRRW	1.985	0.903	4.361
SPRNKLR	0.854	0.341	2.139
FAMOWN	1.285	0.528	3.125
Q9	0.506	0.226	1.133
Q11	0.924	0.795	1.074
OVERTEN	0.534	0.199	1.430
Q41	1.011	0.999	1.023

Hypothesis 11b

The REG Procedure

Dependent Variable: TTLHRDW <ttlhrdw> Variable indicating the total number of hardware changes that were implemented, with the maximum number possible being 7

Number of Observations Read	249.000
Number of Observations Used	232.000

R-Square	0.233
Adj R-Sq	0.191
Dependent Mean	3.112
Coeff Var	48.285

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	3.471	0.561	6.190	<.0001
OWNALL	-0.097	0.240	-0.400	0.687
CROPS	0.554	0.301	1.840	0.067
DAIRYFM	0.040	0.467	0.080	0.933
LIVESTK	-0.219	0.529	-0.410	0.680
ORCHARD	0.612	0.272	2.250	0.026
FLDFRRW	-0.832	0.262	-3.170	0.002
SPRNKLR	-0.554	0.290	-1.910	0.058
FAMOWN	0.500	0.272	1.840	0.067
Q9	-1.057	0.257	-4.120	<.0001
Q11	0.014	0.049	0.280	0.782
OVERTEN	0.576	0.302	1.910	0.058
Q41	0.009	0.003	2.530	0.012

Hypothesis 12 & 14

The LOGISTIC Procedure

Response Variable	Q29BA

<q29ba> Did you install and use tools or instruments to measure soil moisture in the field?

Number of Observations Read	249.000
Number of Observations Used	111.000

Probability Modeled Is Q29BA='1'.

R-Square	0.262	**Max-rescaled R-Square**	0.354

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	33.719	17.000	0.009
Score	27.923	17.000	0.046
Wald	20.457	17.000	0.252

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	4.506	2.149	4.395	0.036
Q27	0.037	0.203	0.033	0.857
Q28	-0.422	0.235	3.237	0.072
OWNALL	-0.661	0.591	1.249	0.264
Q3	-0.264	0.242	1.187	0.276
Q4	0.269	0.212	1.609	0.205
CROPS	-1.359	0.783	3.015	0.083
DAIRYFM	-1.913	1.142	2.809	0.094
LIVESTK	-1.478	1.577	0.878	0.349
ORCHARD	-0.678	0.714	0.900	0.343
FLDFRRW	-1.015	0.703	2.086	0.149
SPRNKLR	-0.605	0.604	1.003	0.317
FAMOWN	1.369	0.585	5.483	0.019
Q43AGE	-0.020	0.025	0.612	0.434
Q9	-1.145	0.794	2.077	0.150
Q11	-0.057	0.157	0.130	0.718
OVERTEN	0.464	0.729	0.404	0.525
Q41	0.019	0.015	1.473	0.225

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	1.037	0.697	1.543
Q28	0.656	0.414	1.038
OWNALL	0.517	0.162	1.645
Q3	0.768	0.478	1.234
Q4	1.309	0.864	1.984
CROPS	0.257	0.055	1.191
DAIRYFM	0.148	0.016	1.383
LIVESTK	0.228	0.010	5.016
ORCHARD	0.508	0.125	2.058
FLDFRRW	0.362	0.091	1.437
SPRNKLR	0.546	0.167	1.784
FAMOWN	3.931	1.250	12.361
Q43AGE	0.981	0.934	1.030
Q9	0.318	0.067	1.510
Q11	0.945	0.694	1.286
OVERTEN	1.590	0.381	6.638
Q41	1.019	0.989	1.050

Hypothesis 12 & 14

The LOGISTIC Procedure

Response Variable	Q29CA

<q29ca> Did you convert from surface to drip or sprinkler irrigation for some or all irrigations during the season?

Number of Observations Read	249.000
Number of Observations Used	107.000

Probability Modeled Is Q29CA='1'.

R-Square	0.255	**Max-rescaled R-Square**	0.340

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	31.426	15.000	0.008
Score	27.221	15.000	0.027
Wald	20.047	15.000	0.170

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	3.380	2.013	2.820	0.093
Q27	-0.068	0.216	0.098	0.754
Q28	0.284	0.242	1.387	0.239
OWNALL	-0.481	0.593	0.658	0.417
Q3	-0.203	0.213	0.904	0.342
Q4	-0.096	0.207	0.214	0.644
CROPS	0.093	0.661	0.020	0.888
DAIRYFM	0.568	0.938	0.367	0.545
FLDFRRW	-1.626	0.712	5.221	0.022
SPRNKLR	-1.212	0.629	3.714	0.054
FAMOWN	0.095	0.572	0.028	0.868
Q43AGE	0.036	0.025	2.049	0.152
Q9	-1.798	0.842	4.560	0.033
Q11	-0.333	0.168	3.955	0.047
OVERTEN	1.527	0.889	2.949	0.086
Q41	0.001	0.007	0.024	0.876

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	0.935	0.612	1.426
Q28	1.329	0.828	2.133
OWNALL	0.618	0.193	1.977
Q3	0.817	0.538	1.240
Q4	0.909	0.605	1.364
CROPS	1.098	0.300	4.011
DAIRYFM	1.764	0.281	11.085
FLDFRRW	0.197	0.049	0.793
SPRNKLR	0.298	0.087	1.021
FAMOWN	1.100	0.359	3.371
Q43AGE	1.037	0.987	1.090
Q9	0.166	0.032	0.863
Q11	0.717	0.516	0.995
OVERTEN	4.602	0.806	26.280
Q41	1.001	0.988	1.014

Hypothesis 12 & 14

The LOGISTIC Procedure

Response Variable	Q29DA

<q29da> Did you convert from open ditch to gated pipe or sprinkler irrigation?

Number of Observations Read	249.000
Number of Observations Used	99.000

Probability Modeled Is Q29DA='1'.

R-Square	0.103	**Max-rescaled R-Square**	0.139

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	10.738	15.000	0.771
Score	9.775	15.000	0.834
Wald	8.548	15.000	0.900

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-2.197	1.963	1.253	0.263
Q27	0.006	0.201	0.001	0.974
Q28	0.149	0.214	0.484	0.487
OWNALL	-0.049	0.571	0.007	0.932
Q3	-0.014	0.201	0.005	0.945
Q4	0.206	0.188	1.206	0.272
CROPS	0.076	0.585	0.017	0.897
DAIRYFM	0.596	0.861	0.479	0.489
FLDFRRW	-0.244	0.677	0.130	0.718
SPRNKLR	-0.074	0.576	0.017	0.898
FAMOWN	0.237	0.540	0.193	0.661
Q43AGE	0.014	0.024	0.358	0.550
Q9	-0.234	0.688	0.116	0.733
Q11	-0.235	0.145	2.622	0.105
OVERTEN	1.283	0.889	2.083	0.149
Q41	-0.010	0.010	1.082	0.298

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	1.006	0.679	1.493
Q28	1.160	0.763	1.765
OWNALL	0.952	0.311	2.913
Q3	0.986	0.665	1.463
Q4	1.229	0.851	1.774
CROPS	1.078	0.343	3.395
DAIRYFM	1.814	0.336	9.804
FLDFRRW	0.783	0.208	2.952
SPRNKLR	0.929	0.300	2.870
FAMOWN	1.267	0.440	3.651
Q43AGE	1.014	0.968	1.063
Q9	0.791	0.206	3.044
Q11	0.791	0.595	1.051
OVERTEN	3.608	0.632	20.607
Q41	0.990	0.971	1.009

Hypothesis 12 & 14

The LOGISTIC Procedure

Response Variable	Q29EA

<q29ea> Did you change hardware configurations based on an irrigation system evaluation?

Number of Observations Read	249.000
Number of Observations Used	108.000

Probability Modeled Is Q29EA='1'.

R-Square	0.095	**Max-rescaled R-Square**	0.127

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	10.735	15.000	0.771
Score	10.210	15.000	0.806
Wald	9.265	15.000	0.863

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	0.321	1.706	0.035	0.851
Q27	-0.023	0.184	0.015	0.902
Q28	-0.056	0.195	0.082	0.774
OWNALL	-0.430	0.501	0.735	0.391
Q3	-0.020	0.195	0.010	0.919
Q4	0.087	0.175	0.249	0.618
CROPS	0.511	0.548	0.870	0.351
DAIRYFM	0.900	0.886	1.031	0.310
FLDFRRW	-0.895	0.657	1.859	0.173
SPRNKLR	0.218	0.535	0.166	0.684
FAMOWN	0.382	0.510	0.563	0.453
Q43AGE	0.014	0.022	0.427	0.513
Q9	-1.139	0.758	2.260	0.133
Q11	0.052	0.139	0.141	0.708
OVERTEN	0.257	0.671	0.147	0.701
Q41	0.002	0.005	0.084	0.772

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	0.978	0.681	1.403
Q28	0.946	0.645	1.386
OWNALL	0.651	0.244	1.738
Q3	0.980	0.669	1.437
Q4	1.091	0.775	1.537
CROPS	1.667	0.570	4.879
DAIRYFM	2.460	0.433	13.975
FLDFRRW	0.409	0.113	1.480
SPRNKLR	1.244	0.436	3.545
FAMOWN	1.466	0.540	3.981
Q43AGE	1.014	0.972	1.059
Q9	0.320	0.072	1.414
Q11	1.053	0.802	1.383
OVERTEN	1.293	0.347	4.814
Q41	1.002	0.991	1.012

Hypothesis 12 & 14

The LOGISTIC Procedure

Response Variable	Q29FA

<q29fa> Did you install additional pressure gauges at equipment stations for drip or sprinkler systems?

Number of Observations Read	249.000
Number of Observations Used	107.000

Probability Modeled Is Q29FA='1'.

R-Square	0.338	**Max-rescaled R-Square**	0.452

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	44.055	14.000	<.0001
Score	36.765	14.000	0.001
Wald	25.918	14.000	0.027

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	6.503	2.176	8.936	0.003
Q27	-0.582	0.272	4.587	0.032
Q28	0.252	0.269	0.874	0.350
OWNALL	-1.160	0.650	3.191	0.074
Q3	-0.172	0.224	0.587	0.444
Q4	-0.220	0.223	0.971	0.324
CROPS	1.110	0.744	2.225	0.136
FLDFRRW	-1.851	0.720	6.614	0.010
SPRNKLR	-1.596	0.680	5.513	0.019
FAMOWN	-0.918	0.633	2.105	0.147
Q43AGE	0.003	0.026	0.018	0.895
Q9	-1.456	0.861	2.863	0.091
Q11	-0.039	0.173	0.052	0.820
OVERTEN	1.777	0.894	3.957	0.047
Q41	0.009	0.012	0.583	0.445

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	0.559	0.328	0.952
Q28	1.286	0.759	2.179
OWNALL	0.313	0.088	1.119
Q3	0.842	0.543	1.307
Q4	0.802	0.518	1.243
CROPS	3.034	0.706	13.045
FLDFRRW	0.157	0.038	0.644
SPRNKLR	0.203	0.053	0.768
FAMOWN	0.399	0.116	1.380
Q43AGE	1.003	0.954	1.055
Q9	0.233	0.043	1.259
Q11	0.961	0.685	1.349
OVERTEN	5.914	1.027	34.075
Q41	1.009	0.986	1.032

Hypothesis 12 & 14

The LOGISTIC Procedure

Response Variable	Q29GA

<q29ga> Did you replace or rebuild the bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	105.000

Probability Modeled Is Q29GA='1'.

R-Square	0.296	**Max-rescaled R-Square**	0.461

Testing Global Null Hypothesis: BETA=0

Test Chi-Square DF Pr>ChiSq			
Likelihood Ratio	36.808	15.000	0.001
Score	29.097	15.000	0.016
Wald	18.412	15.000	0.242

Parameter	Estimate	Standard Error	Wald Chi-Square	Pr > Chi Sq
Intercept	1.707	2.673	0.408	0.523
Q27	-0.302	0.329	0.842	0.359
Q28	0.663	0.367	3.260	0.071
OWNALL	-0.567	0.904	0.393	0.531
Q3	0.445	0.258	2.975	0.085
Q4	0.046	0.255	0.033	0.857
CROPS	0.499	1.039	0.231	0.631
DAIRYFM	0.082	1.312	0.004	0.950
FLDFRRW	1.020	1.239	0.678	0.411
SPRNKLR	-0.776	0.837	0.859	0.354
FAMOWN	-0.531	0.790	0.452	0.502
Q43AGE	0.018	0.035	0.263	0.608
Q9	-1.985	0.969	4.192	0.041
Q11	-0.665	0.301	4.889	0.027
OVERTEN	0.437	1.036	0.178	0.673
Q41	0.073	0.046	2.545	0.111

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	0.739	0.388	1.410
Q28	1.941	0.945	3.986
OWNALL	0.567	0.096	3.339
Q3	1.560	0.941	2.586
Q4	1.047	0.635	1.727
CROPS	1.648	0.215	12.628
DAIRYFM	1.086	0.083	14.207
FLDFRRW	2.773	0.244	31.453
SPRNKLR	0.460	0.089	2.375
FAMOWN	0.588	0.125	2.767
Q43AGE	1.018	0.951	1.090
Q9	0.137	0.021	0.919
Q11	0.514	0.285	0.927
OVERTEN	1.548	0.203	11.783
Q41	1.075	0.984	1.175

Hypothesis 12 & 14

The LOGISTIC Procedure

Response Variable	Q29HA

<q29ha> Did you regularly adjust bowls on deep well pumps?

Number of Observations Read	249.000
Number of Observations Used	105.000

Probability Modeled Is Q29HA='1'.

R-Square	0.306	**Max-rescaled R-Square**	0.419

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	**DF**	**Pr > Chi Sq**
Likelihood Ratio	38.372	17.000	0.002
Score	31.460	17.000	0.018
Wald	20.633	17.000	0.243

Parameter	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**
Intercept	-5.433	2.469	4.843	0.028
Q27	-0.100	0.253	0.155	0.694
Q28	0.003	0.251	0.000	0.989
OWNALL	0.311	0.630	0.243	0.622
Q3	0.719	0.320	5.051	0.025
Q4	0.325	0.249	1.705	0.192
CROPS	1.271	0.816	2.426	0.119
DAIRYFM	1.714	1.148	2.228	0.136
LIVESTK	14.478	525.500	0.001	0.978
ORCHARD	0.167	0.769	0.047	0.828
FLDFRRW	-0.224	0.794	0.080	0.778
SPRNKLR	-1.501	0.762	3.877	0.049
FAMOWN	1.277	0.732	3.040	0.081
Q43AGE	-0.005	0.028	0.036	0.850
Q9	-0.559	0.899	0.386	0.535
Q11	-0.218	0.178	1.494	0.222
OVERTEN	-0.903	1.022	0.781	0.377
Q41	0.008	0.006	1.629	0.202

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Q27	0.905	0.551	1.487
Q28	1.003	0.614	1.640
OWNALL	1.364	0.397	4.690
Q3	2.053	1.096	3.845
Q4	1.384	0.850	2.254
CROPS	3.563	0.720	17.624
DAIRYFM	5.552	0.585	52.725
LIVESTK	>999.999	<0.001	>999.999
ORCHARD	1.182	0.262	5.328
FLDFRRW	0.799	0.169	3.788
SPRNKLR	0.223	0.050	0.993
FAMOWN	3.585	0.853	15.064
Q43AGE	0.995	0.941	1.051
Q9	0.572	0.098	3.334
Q11	0.804	0.567	1.140
OVERTEN	0.405	0.055	3.003
Q41	1.008	0.996	1.021

Hypothesis 12 & 14

The REG Procedure

Dependent Variable: TTLHRDW <ttlhrdw> Variable indicating the total number of hardware changes that were implemented,
with the maximum number possible being 7

Number of Observations Read	249.000
Number of Observations Used	112.000
Number of Observations with Missing Values	137.000

R-Square	0.369
Adj R-Sq	0.255
Dependent Mean	3.500
Coeff Var	37.012

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.754	1.016	4.680	<.0001
Q27	-0.129	0.115	-1.130	0.263
Q28	0.066	0.117	0.570	0.573
OWNALL	-0.598	0.311	-1.930	0.057
Q3	-0.018	0.116	-0.160	0.877
Q4	0.148	0.110	1.350	0.181
CROPS	0.280	0.404	0.690	0.490
DAIRYFM	0.220	0.588	0.370	0.709
LIVESTK	-0.665	0.841	-0.790	0.431
ORCHARD	0.226	0.371	0.610	0.544
FLDFRRW	-0.807	0.398	-2.030	0.046
SPRNKLR	-0.873	0.351	-2.490	0.015
FAMOWN	0.286	0.307	0.930	0.354
Q43AGE	0.018	0.014	1.330	0.188
Q9	-1.147	0.418	-2.750	0.007
Q11	-0.144	0.083	-1.730	0.088
OVERTEN	0.540	0.425	1.270	0.207
Q41	0.004	0.003	1.080	0.284