

Attitudes of Georgia Irrigators Regarding the Use of Water Meters

Water Policy Working Paper #2003-001

Mark Morrison*, Nancy Norton, Virgil Norton**, and David Eigenberg****

*** Visiting Professor, Georgia State University (Dec 2001-August 2002)
Faculty of Commerce, Charles Sturt University (September 2002 -)**

**** Associate Professor, Professor, and Research Associate, respectively
Flint River Water Planning and Policy Center, Albany State University**

**The authors greatly appreciate the assistance of
Warren Holton, Camilla, GA**

**Marshall Lamb, USDA National Peanut Research Laboratory, Dawson, GA
Rad Yager, University of Georgia Stripling Irrigation Research Park, Camilla, GA
and the**

**Farmers in SW Georgia who were willing to take the time and to express their ideas,
concerns, and suggestions regarding the potential use of irrigation water flow meters.**

January 2003

Attitudes of Georgia Irrigators Regarding the Use of Water Meters

Executive Summary

Water-use measuring devices such as flow meters are common in some areas of the U.S. as a component of irrigation management practices. Flow meters are relatively accurate indicators of how much water is being used, and can help farmers optimize irrigation water use and crop yields. Measuring, reporting, and analyses of water use data can also provide guidance to policy makers, and be an important input to science-based hydrology and other models. While water meters may enhance private and public water management, it has been the experience in other states that not all farmers respond positively (some even strongly resist) to the potential requirement of using water meters.

During the summer of 2002, a sample of irrigators in SW Georgia participated in a survey to determine the extent of farmers' knowledge of and attitudes about water meters. Results indicate that most participants had little knowledge and understanding of meters and how they might be used. Only about half of the farmers surveyed believe that water meters will improve irrigation management. Several already measure water use with rain gauges or system charts, and believe these to be sufficient. They consider the cost of installing water meters to be an unnecessary expenditure.

Participants expressed concern about being required to install and use water meters, and indicated hesitancy to voluntarily purchase and install meters. Their concerns included: costs; uncertainty about the need for and potential benefits of meters; and suspicion of how meters might accelerate government regulation of irrigation water use. While the majority of farmers in the survey felt that water meters would have advantages, just as many perceived that there might be associated disadvantages.

Some participants indicated they would *consider* installing meters, but their willingness-to-pay was generally much less than the purchase price. This suggests that subsidies will be a necessity for encouraging widespread voluntary adoption of water meters.

Several farmers in the sample indicated that they would respond positively to cost-share. While the suggested subsidy varied, no one indicated a willingness to accept less than a 50% cost-share. About three-fifths of the participants, who specified a necessary amount, said they would require cost-share in the range of 75 to 100%, or a full 100%. Furthermore, some participants said they would be unwilling to voluntarily adopt water meters, regardless of the level of cost-share, either because of concerns about costs, doubts about the benefits of water meters, and/or fear of regulation.

TABLE OF CONTENTS

I.	Introduction	1
II.	Survey Logistics and Sample Design	3
III.	Three Stages of Consumer New Product Decision Making: Summary of Survey Responses	3
	A. The Cognitive Stage	4
	<u>Farmers Awareness and Knowledge of Water Meters</u>	4
	B. The Affective Stage	6
	<u>Farmers Attitudes about Water Meters</u>	6
	<u>Advantages of Water Meters</u>	6
	<u>Certainty about the Benefits of Using Water Meters</u>	8
	<u>Disadvantages of Water Meters</u>	9
	<u>Perceptions of the Attitudes of Other Farmers regarding the Use of Water Meters</u>	10
	<u>Conviction: Willingness to Purchase and Pay for Water Meters</u>	12
	C. The Behavioral Stage	14
	<u>Potential Effects of Incentives on the Adoption of Water Meters</u>	14
IV.	Summary and Conclusions	16
	<u>Summary</u>	16
	<u>Conclusions</u>	17
	Selected References	18
	Appendix A: Questionnaire	19
	Appendix B: Water Meters Booklet	20

Attitudes of Georgia Irrigators Regarding the Use of Water Meters

I. Introduction

Historically Georgia's irrigators have enjoyed an abundance of surface and ground water. In recent years, however, falling aquifer levels in some areas, salt water intrusion in coastal aquifers, and drought-induced low surface water flows have generated concerns within Georgia about scarcity, and led to threats of litigation with neighboring states. As a result, there are proposed legislative actions that may expand water management programs in the State. One such action under consideration is to require that agricultural water use be measured.

Water-use measuring devices such as flow meters are common in some areas of the U.S. as a component of irrigation management practices. There are several kinds of water meters that can be used to indicate instantaneous and accumulated water use. The propeller type is typically used for measuring irrigation water use. Water meters have several advantages. For farmers, they are relatively accurate indicators of how much water is being used. This is important for optimizing irrigation water use and crop yields, and may help in diagnosing irrigation system inefficiencies. Also, measuring, reporting, and analyses of water use data can provide guidance to policy makers, and be an important input to science-based hydrology and other models.

While water meters may enhance private and public water management, it has been the experience in other states that not all farmers respond positively to the potential requirement of using water meters. Some even strongly resist -- arguing that such requirements are, or will become a regulatory measure and method of government control. For these reasons, water meters, despite having possible advantages, represent a product that few irrigators (anecdotally, at least) wish to adopt. Therefore, the process involved in the adoption of water meters can be seen as a "social marketing" issue, with the associated challenge of how to most efficiently and effectively introduce such a water management practice.

In marketing research, the 'Hierarchy-of-Effects Model' (HEM) or similar models are used to understand the effectiveness of attempts to persuade people to use new products or technologies (Lavidge and Steiner, 1961; Barry, 1987). The HEM portrays consumers as passing through three stages when considering and deciding to purchase or use a product. These stages

are: 1) the cognitive stage, which includes initial awareness and knowledge; 2) the affective stage, which includes attitudes about the product, measures of certainty regarding the product's benefits, and conviction about purchasing; and 3) the behavioral stage, which indicates the consumer's act of purchasing.

The positioning of consumers across these stages provides guidance about appropriate methods of marketing communication. For instance, if consumers generally have low awareness of a product and little information, then promotional strategies should focus on informing consumers about the product and its benefits. If, however, consumers are primarily in the affective stages, the promotion should be more persuasive in nature, and possibly include the use of incentives.

The primary purpose of this paper is to provide information, in terms of these three stages, about the position of Georgia irrigators with regard to the adoption of water meters. Understanding where farmers are in the HEM can be useful to policy makers in deciding the mix of promotion, incentives, and regulation needed to encourage the adoption of water meters.

Within the framework of the HEM and the associated three stages of consumer decision-making, this research is designed to examine the validity of four propositions that are often suggested as relevant to the water meter debate. These are:

- P₁: Farmers believe that water meters will help them improve irrigation management*
- P₂: Farmers, without incentives, will not voluntarily adopt water meters because of concerns about cost and regulation*
- P₃: Farmers believe that some other farmers will react negatively if they begin using water meters*
- P₄: Farmers will voluntarily adopt water meters if appropriate financial incentives are offered.*

The structure of this paper is as follows. In Section II the survey logistics and sample are described; Section III presents an overview of farmers' responses to survey questions and how these responses reflect the three stages of consumer decision-making when faced with the possible purchase/use of a new product (i.e., water meters); and summary and conclusions are offered in Section IV.

II. Survey Logistics and Sample Description

In-depth personal interviews were conducted with 30 irrigation farmers in the Flint River Basin during the summer of 2002. A trained interviewer, who has a background in farming and lives in southwest Georgia, conducted all interviews. Recruitment of farmers was based on a non-probability sampling procedure. The use of non-probabilistic sampling procedures for qualitative research is standard practice (Malhotra, 1999). Lists provided by the USDA National Peanut Research Laboratory, Albany State University Flint River Water Planning and Policy Center, and University of Georgia Stripling Irrigation Research Park were used to recruit farmers. The questionnaire (a copy of which is presented in Appendix A) was organized within the framework of the three stages of consumer decision-making comprising the HEM. Interviews lasted about 1.5 to 2 hours, and respondents were given an incentive (meal coupon at local restaurant) to participate.

The socio-demographics of participating irrigators are summarized as follows:

- The average age of respondents was 48 years (*standard deviation = 9.4 years*).
- A majority of respondents were college educated (20 of 30).
- Farming was the main source of income for most respondents (28 of 30).

The respondent's average farm size was 1,982 acres (*standard deviation = 1,220 acres*). The main crops grown and percent of respondents growing these crops were: peanuts - 93%; cotton - 82%; corn - 61%; pecans - 25%; and wheat and other small grains - 14 %. About 14% of the respondents also raised cattle. All respondents used groundwater for irrigation, and 20% also used surface water. On average, participating farmers irrigated 82% of their cropland (*standard deviation = 15%*).

III. The Three Stages of Consumer New Product Decision-Making: Summary of Survey Responses

Discussed in this section are results of the survey, presented in an order that reflects the three stages of consumer decision-making specified in the Hierarchy-of-Effects Model.

A. The Cognitive Stage

Farmers Awareness and Knowledge of Water Meters

The first set of questions focused on farmers' awareness and knowledge of water meters. These questions relate to the *cognitive* stage of the HEM. From a social marketing perspective, what is important at this stage is to gauge farmers' awareness of water meters and their purpose. Participating farmers were asked about the importance, methods, and uses of measuring water in their irrigation operations. These were followed up with questions on their opinions concerning water meters as a measuring tool.

About 83% of all respondents felt it was "very important" or "important" to know the amount of water that they use. The reasons cited included (number of respondents in parentheses – some respondents gave more than one reason):

- Ensuring that adequate water was applied to meet crop needs (9);
- Not wasting water or over-watering, which may cause disease and/or fertilizer leaching problems (8);
- Obtaining optimal yields (3);
- Creating their own records for use in case of future regulation (7); and
- Controlling the fuel expense related to pumping water (5).

Some quotes on why farmers want to know the amount of water they use include:

To get a better handle on what I'm doing. I'm not always aware of the amount that we're putting out or...I hate to say this because it sounds ignorant, but sometimes we're not aware of the expenditures that we're making, and I'd like to know exactly how much water we're putting out so I can check it better. You can check your yields, and you can check your expenses.

Because you can over-water a crop and get disease in it, and you can under-water a crop and lose it, burn it up...drought. You need to be on top of your irrigation.

I think it's going to be very important to know in the future because if we're ever regulated. If you kept good records on what you have used, it will probably help you. You'll have something to fall back on; to say this is what I used.

Well, with the regulations that they're coming up with now and possibly putting a cap on how much you can use, you'd want to know if you could get by with what they might regulate you to.

Eighteen of the 30 participants said they use rain gauges to determine the amount of water applied. More than one-fourth of participating farmers used the systems chart that came with their irrigation system, even though this method is based on data obtained in controlled studies, and may not be indicative of system performance in the field. Several of these farmers

also used rain gauges to verify the amounts applied. Five respondents said that they do not keep records on water use during the season. Among those farmers in the survey that used some method of measuring water use, most (77%) would like to improve the accuracy of the method.

After questions about water use and current measurement techniques, the irrigators were asked the following:

- a. What do you think about using water meters for this purpose?
- b. What is the first thing that comes into your mind when you think of water meters?
- c. What do you know about water meters?

The answers to these questions illustrate that some participants had little or no knowledge of meters. About one-third knew meters had something to do with measuring water or the flow of water through the system, but indicated a lack of knowledge, by responding “nothing”, “not much”, or “very little” to question (c) above. Only a few respondents could see a water meter as being a tool that would help them to manage their own water use. Several participating farmers apparently thought that meters record only the instantaneous flow of the well (in gallons per minute), and were not aware that accumulated pumping was also recorded. They were also not aware that meters can record accumulated use in units other than gallons (such as acre-inches). Therefore, they perceived meters only as a way to verify previous information about their system’s pump rate, and not as a farm management tool. These results indicate that any promotional strategy to encourage the use of water meters should include basic information about what water meters are, the type of information that they provide, and how they can be used to improve irrigation management.

With respect to question (b), almost two-thirds (64%) of respondents thought that water meters could be related to controlling their water use in the future. A sample of the responses to the question “What is the first thing that comes into your mind when you think about water meters?” is as follows:

First thing that comes to my mind is thinking that would be something mandatory that the State put on the systems to keep up with how much water we’re using. That makes me think that one day we’re going to get so many gallons per acres and those meters would be used to keep up with them. I know that’s a bad way to think about it.

Government regulations and them telling me how much I can use and can’t use.

Politicians wanting to control. Not as much politicians as bureaucrats.

Regulation. Complications. Better underline that one.

Regulatory efforts. By the government, that's what comes into my mind.

Regulations is what most of us think.

Trying to limit the water. Somebody trying to tell you your using too much.

Controlling my water supply.

B. The Affective Stage

Farmers Attitudes About Water Meters

After being asked questions about their knowledge of water meters, farmers were shown a booklet describing a propeller type flow meter (see Appendix B). They were also shown an actual propeller flow meter. Farmers were then asked a series of questions to determine their attitude about, and intended future use of water meters. These questions relate to next stage of the Hierarchy-of-Effects Model, the *affective* stage. At this stage it is important to determine whether potential users like the product or not, and why. If potential users (farmers, in this case) have reservations about the product, it may be possible to provide educational programs, such as the use of field demonstrations, to address their concerns. Or if cost is the main concern, subsidies could be offered.

Advantages of Water Meters

First, participants were asked what they perceived to be the advantages of using flow meters. Approximately two-thirds of the participants felt that water meters would have advantages. Most of these thought that they would provide more accurate information that would help in applying the optimal quantity of water for their crop. Examples of these responses include:

They can give you a real accurate reading on exactly how much water you are using. If you haven't got a water meter, you're just going by what you're rated at. You may be below that rate or above. That meter will tell you exactly where you are. It would probably surprise you if you put on a meter, it would surprise you how much water you actually use.

The advantages would be to tell you exactly how much water you put down because if you ain't using nothing its just guess work and that's exactly what I've been doing and most of other farmers too.

...[it] will let you know if you're getting correct flow from your pumps and it gets the correct inches out. A lot of time the charts aren't as accurate as we'd like to think they are.

Well they would let me know how much water is going through the system, getting a more accurate amount. In the past we were going by whatever the capacity of the well is, 1200 gallons or 1800 gallons, I've had this Water Management Tips and hooked up computers onto it and I found out that it was not accurate to go by that...more or less than what they say by the chart, because a 1200 gallon per minute capacity pump

from behind by the house was pumping 1470...so there is not a way of knowing without having some kind of flow meter.

Other respondents saw the main advantage as being able to diagnose the existence of problems with their irrigation systems:

Well, if you had a pump problem it would probably help you find it. If you were losing water pressure or a pump problem or an engine problem, it would probably help you find it a little quicker.

You will know on each pivot exactly how much you're putting out so you know how to set your timer on how much water. Like I said, if you think you're putting out an inch and you're putting out three-fourth inch, you're just hurting yourself. And it's a lot easier. If something went wrong with your well or your propeller or the pressure, you would know it right away. Not something you would find out later.

Two respondents thought that the main advantage would be the ability to demonstrate their actual water use if restrictions on water use occurred in the future:

I think the only advantage of using water meters would be if you were going to have a restriction on the amount of water you can pump through that system. That's the only advantage I can see to it.

However, nearly one-third of the farmers surveyed could not identify any advantages of water meters:

I don't see a whole lot of advantages.

I don't see any advantage for water meters except for gathering data for this water research project. Don't know enough about them.

None. I'm sure there are, I just don't know what they are.

Two farmers felt that rain gauges provided them with sufficient information:

The only advantage that I know of at this point and time would be to know what your actual well is doing. As far as what the system is doing, you can do it with rain gauges, pretty well close. As far as a flow meter on it, it's just the knowledge of knowing the gallons that are actually going through the system.

I don't see an awful lot of advantages in them ... a rain gauge does fine with me. It's (a meter) got some advantages, but it's not worth that price to me.

Two participants were negative towards water meters because they felt it would be difficult to convert readings on flow meters to inches per acre. This suggests the importance of providing educational material to farmers, to inform them that meters can be purchased which record accumulated use in acre-inches.

I think it is important to know how much water I'm applying to my land when I irrigate, in inches which is something I can relate to. When I look at this meter and it tells me that if I multiply it by 4, I come to acre-feet then I got to divide it by 12 to get inches. Well I think it would be simpler to monitor the output of my irrigation system with a rain gauge. The fact that a piece of my machinery breaks down overnight and pumps a million and a half gallons in one spot, I hate it, but the fact that I can read it on the meter [doesn't help that much]. I know it when I see the water is flowing down the road.

The advantages of using a water meter is not many unless they are able to figure out how to convert it and a foreman or farmer can understand and use. If they say converted to... how much in inches or tenths of inches you're putting out, then I think it would be very useful to the farmer because he'll know what he is doing.

Certainty about the Benefits of Using Water Meters

In previous research on the adoption of new technologies, a key factor that has been found to influence adoption is risk (Lynne et al., 1988). One reason farmers have been found to delay adoption of new technologies is uncertainty about the benefits. It is common for the majority of farmers to watch how well a technology has performed when used by “innovators” and “early adopters”, and then adopt the technology if it has performed satisfactorily (Rogers and Shoemaker, 1971). Therefore, it is useful to know how convinced farmers are about the benefits of water meters, as this may be an indicator of whether the majority of farmers would be likely to adopt water meters in the short-term.

Questions were asked to determine the level of certainty among participants that the use of water meters would assist with (1) improving irrigation management, and (2) increasing yields. These questions were:

- a. Do you think that the use of water meters would improve irrigation water management?
How certain would you say you are about this (very certain, certain, uncertain)?
- b. Do you think that the use of water meters would lead to increased yields through changes in management from extra information? How certain would you say you are about this (very certain, certain, uncertain)?

Only four of the participants were “very certain” that the use of water meters would improve water management. Another eleven farmers thought that it would, but were less certain. Four farmers were not sure that the use of water meters would improve irrigation management. Nine participants thought that meters would not improve irrigation management, and two did not answer this question. The attitudes of participants about the potential effects on yields were distributed similarly. Uncertainty about the benefits of using meters is illustrated in the following comments:

I don't really see its use as long as you know what sprinkler package that you've got on that pivot is putting out. As long as you know that you're putting out an inch or half-inch or ¾ inch, I don't see how you'd need to be worried about a water meter ... It'll make me cut a whole in a piece of pipe that wasn't leaking when I didn't have a leak. I already got enough leaks.

At this point and time I wouldn't say that it would be a major factor in the management end. I think knowing the inches going in or what you're putting out on the actual crop is more important than knowing how many gallons are going through the system.

I think what's more important would be figuring out how much water somebody is using, and water meters don't necessary tell the story. The best way to figure out what you're using is getting a string of rain gauges and putting them down the field and when the computer passes over them, seeing whether your system is putting out properly or not. A water meter wouldn't necessarily do that. The efficiency in your system is more important than a water meter.

No, I'm certain because I don't think anybody would look at the gallons and try to figure out the inches.

Probably over a period of years if a man would keep up with what he is doing he and be able to look back he probably definitely could, but we're not too good at that either. Don't seem like there is no purpose for them if you do what you did last year.

I don't think that information would register. I don't know I just think we do things by the seat of our pants; we have a schedule that's what we get on with and stay with it.

These responses suggest that there is considerable doubt among some farmers about how water meters can be used to assist with irrigation management, and again misinterpretation regarding the units in which water use can be recorded with meters. To some extent, this is to be expected given the limited experience with using water meters in the Flint River Basin. It also suggests that without educational programs and the use of incentives or regulation, many farmers will not voluntarily choose to use water meters.

Disadvantages of Water Meters

Farmers were also asked what they thought were the disadvantages of water meters. About one-third of respondents could not identify any disadvantage of using water meters. Another third thought that a disadvantage was the cost of purchasing a water meter or the extra management burden.

Cost and additional management.

Other than the cost of putting it in, I can't see any disadvantages.

The complication and the cumbersomeness of an additional record keeping process.

Cost, \$800 for a water meter when a \$2 rain gauge will tell you that.

Just something else to break down. I know what you said about them but they break too, and cost -- you have to put 8 or 10 of them in, it runs into some money.

The only disadvantage I can see is that \$800.

Almost one-third of farmers identified regulation as a primary concern. They thought that the use of water meters would assist the government in regulating water use:

...one of the things...in my mind and hearing others talk, some of them would probably say that if we know exactly how many gallons of water we're using and then if they put us on a quota system or a budget system it might get cut more than if you didn't really know how much water you're using. Whether that would be accurate I don't really know.

Well, I don't know if it couldn't be used against us by the water EPA or some others who are trying to determine how much water we are using.

The main negative thing on the water meters is I guess everybody thinking about the State putting a meter on our well to regulate us.

For government regulation would be the only disadvantage that I can think of and putting us on a quota basis or something like that, I would not like.

I don't know if there is one other than if it is the beginning of controlling the water that you're pumping. That would be the only disadvantage I see if that's where it's going to. Nothing negative about knowing what's going through your well, but if it's fixing to be a controlling factor, this is where I see there might be some negative.

The only thing I could see really is it scares me in regulations being able to tell exactly what you're using and say, look, this is all you can use. When you get to that, shut her down.

One farmer also voiced concern with the effect of water meters on pump efficiency:

In some cases where the pump at the well has to operate a maximum capacity in order to operate the system at maximum efficiency there may be a problem with the meter reducing efficiency of the system.

Thus about two-thirds of participants perceived either no disadvantage with using water meters, or feel that cost/labor related issues are the main disadvantage. This suggests that subsidies may be an effective tool in encouraging voluntary adoption of water meters, which will be discussed in Section III.C. However, fear of regulation may cause many of the remaining farmers to be hesitant to adopt water meters voluntarily, even if incentives were offered.

Perceptions of the Attitudes of Other Farmers about the Use of Water Meters

Another construct used to explain technology adoption is farmers' perceptions of what other farmers will think if they begin to use the new technology (Lynne et al., 1995). Farmers were asked the following question:

If you started using water meters, how do you think that other farmers you know would react?

There was a diversity of answers to this question. Slightly over one-third of farmers responded that they thought that other farmers would react with curiosity or in a positive way, as shown in the following comments:

They would be curious. I think they would want to start, if I found out that out of 11 pivots, the information I had on how much gallons per minute were off a considerable amount, it would make a lot of difference.

Curiosity I think that they would want to know how it worked, and if it did some of them would put them in later.

I think most farmers would be positive about installing water meters. The only disadvantage would be cost and it's not that much cost.

Probably to start with some of them would be skeptical about the meter and all, but if you could show them where you increase your yields and profits, that would probably take care of it or it should, anyway.

I have not had any problems and I have asked other farmers what they think about it. I have had no one that would have a problem with putting a meter on.

A few farmers thought, however, that some farmers would react positively and others negatively:

Some farmers would go for it and some would not.

Favorable to some people.

Some would go along with it, and some wouldn't. Some would go back in their hole. They don't want nobody knowing their business.

Several participants thought that other farmers would be indifferent about whether they installed a water meter:

I don't think they would be anything real positive or negative on it. I think it would be pretty well neutral.

Indifferent.

I don't think they would have a reaction, indifferent.

Only a few of the participating farmers thought that other farmers would react negatively:

You don't really want to know. They would think you are a lunatic and you wouldn't catch me dead with one of those things. Most of us feel like you're just asking for trouble. You know ... as well as I do there is a deep mistrust of ... state and federal government to come in and try to take over, and anything to do with water meters automatically raises red flags to most farmers.

They'd just think, well you know how many gallons you got flowing, but what good is it doing.

They might make more fun about that than they would about anything. I don't really know. Sometimes when we try some of these new things it is better to keep quiet about it until someone asks you. If I put in water meters I probably wouldn't tell my neighbors right away.

Overall, these results indicate that the majority of farmers do not consider that other farmers will react negatively to their installing water meters. Most perceive that other farmers would react positively or with indifference. Few farmers thought that their neighbors would react negatively, suggesting that such concern is unlikely to be a major constraint on adoption of water meters.

Conviction: Willingness to Purchase and Pay for Water Meters

Before considering the issue of the effectiveness of incentives, we first report the responses to a question designed to determine whether farmers would be willing to install water meters voluntarily over the next year. The goal of this question is to identify farmers' pre-purchase intentions, which is the final step in the *affective* stage within the Hierarchy-of-Effects Model. This question is of particular interest because it indicates farmers' willingness to pay for water meters in the absence of any incentives such as cost-share. Of the 28 farmers who answered this question, 12 farmers said that they would *consider* installing water meters, 14 said that they would not, and two were not sure. When asked how much they would be willing to pay for water meters, only four of the 12 farmers responded that they would pay the actual cost, and two of the farmers indicated they would pay only \$300-400 -- much less than the purchase and installation costs. The other six, who said they would *consider* installing meters this year, did not specify an amount that they would be willing to pay, raising doubt that they would voluntarily install meters without cost-share.

Farmers were also asked the reasons why they were willing or unwilling to install a water meter. This information could be useful for promoting water meters, as it indicates the main reasons for voluntarily purchasing or not purchasing. A key component of promoting new products is "selling the benefits", especially when cost may be considered to be high. The main reasons given by participants for being willing to consider using water meters included to obtain more accurate information, and to save water and fertilizer:

To make sure each system was putting out the amount of water it was programmed for, and if you are putting out chemicals besides the water, to see if it's putting the amount of chemicals you're supposed to or too much or not enough.

Well, you'd have to figure if you save water on irrigation it would more than save you.

To cut costs of production, and to save on water.

I would consider installing them just to find out how much I am putting out instead of guessing like we normally do.

To increase your accuracy and judging the amount of water you're applying.

To get an accurate reading of how much water I'm putting out. As I said I don't think the charts are all that accurate.

Farmers also had a couple of other motives for installing water meters, including environmental reasons and to protect against future government changes:

To help save water, and if the government wants to come out and check me. Get them officials off me.

The only reason I can think of to install them would be if for some reason they started talking about limiting our water a little bit more than they are then I might want a water meter to back up the amount of gallons I've used. That would be the only reason that I would consider them. Would be just for proof of how much water I use. Cause probably if they're going to go to that, they're going to go to the historical thing first and then they going to cut you 10% or whatever.

For environmental reasons because I like to think we're taking good care of our water resources.

Respondents had various reasons for not wanting to install water meters. For some it was concern about future government regulation:

Just the thought of it - it's just a control issue.

Florida water management districts. They require them down there and my friends that farm in Florida talks about the nightmares and the hoops they have to jump through in these water districts in Florida.

I think that if I installed meters that they would be used to limit my ability to use my water.

Others had doubts about the benefits of meters, and concerns about the costs involved:

The money costs and I really wouldn't feel like it would benefit me any.

Expenses, record keeping, and unreliable equipment.

I don't see the benefits to my yields and to my crops.

The initial cost of the meter and it seems like we been doing pretty good with the system we got and we do everything we can now not to waste any water.

As mentioned above, understanding the reasons why farmers are unwilling to adopt a new technology is useful. From the responses above, cost and uncertainty about benefits appear to be major factors. This could, in part, be dealt with through the use of incentives. The fear of government regulation is, however, a recurrent theme that would be more problematic.

To summarize, in this section we have examined farmers' attitudes about the adoption of water meters by focusing on three issues: the advantages and the disadvantages of using water meters, uncertainty about benefits, and the effect of social norms. Almost two-thirds of farmers thought that the use of water meters would have some advantages. Most of these suggested that the primary advantages would be improved information and the ability to diagnose problems with their irrigation system. However, only a small proportion of farmers were "certain" or "very certain" that water meters would improve water management or lead to increased yields.

Also, about two-thirds of farmers surveyed identified disadvantages that they perceive would come along with the use of water meters, with the most commonly cited disadvantages

being cost, additional management requirements, and regulatory concerns. Only a few farmers thought that their use of meters would cause neighbors to react negatively.

While some participants would *consider* voluntarily adopting water meters in the next year, their willingness to pay was, in general, much less than the purchase price. This suggests that substantial incentives and/or regulation will be a necessary part of achieving rapid and widespread adoption of water meters.

C. The Behavioral Stage

Potential Effects of Incentives on the Adoption of Water Meters

In the previous section, only twelve farmers said “yes” to the question regarding whether they would be willing to voluntarily purchase a meter in the next year. As a follow-up, the sixteen (Note: two of the 30 did not answer the above question, and were not included in this follow-up question) who did not say “yes” were asked the following question:

Suppose that having water meters was a requirement of participating in an incentive scheme, such as the irrigation land retirement auction held the last two years. Would this change your mind about installing water meters?

Support for this proposal was mixed. Four of the sixteen farmers indicated that they would install meters if it were a requirement of participation. Five would not change their mind, and seven were undecided or felt they were ineligible to participate in the auction because they use only groundwater for irrigation. Here is a sample of the responses:

It could change my mind.

I thought about that. It would cause me to have to reflect on it. Because then you're getting down to compensation.

It might, I wouldn't say it absolutely would. These things start out as information gathering techniques, but sometimes they end up working out against us rather than for us. That's why we're leery about some of these things.

If we had to put in water meters to go to the water auction, I wouldn't go to one of them. That's how strongly I feel about that.

The second incentive scheme described to these 16 farmers is as follows:

Here's a different situation. Suppose that because of the disputes with Florida and Alabama over water, the state decided it was going to require farmers to install water

meters in three years time. However, if farmers started using water meters during the next year the state would cost-share the cost of purchase and installation.

Would you consider installing water meters this year if cost sharing were available? If yes, what percentage cost share would be needed for you to install water meters this year?

As would be expected, most of the 16 farmers said that they would install water meters if it was a regulatory requirement, and the only way they could get cost share was to install immediately.

Certainly would there's no doubt about that.

I'm assuming that's saying there would be a certainty within three years you would be required to have one.... Yeah, if they want to cost-share then I would go ahead and do it.

The money incentive will move more people than anything else.

Well if you got to do it anyway, any amount would they help you with, I guess you would go ahead and do it.

Two farmers seemed convinced that water meters are going to be required by the state:

I don't see we got control over anything with water anymore. They do about what they want to do. I still say we need to know, good or bad, how much water we are using. I would agree to it. A lot of these tests for example in the wells to check to see what the aquifer is doing are already going on. And I want to know myself. They're not going to keep it a secret.

I think its coming to that, they're going to put on meters and tell you how much can flow out of that meter.

A few farmers, however, said that they still would not install water meters this year, even if such an incentive were offered.

I couldn't do it this year anyway; the crop is already in the ground and I wouldn't want to be down because it's already hitting 90-95 degrees every day and we're having to water on a twice-weekly basis already. We couldn't afford the down time. If they want to do something like that, they're going to need to do it in the winter.

One was concerned about the details of the scheme. This suggests the importance of being specific about any requirements attached to a cost-share program:

Before I say yes to that I'd want to know what stipulations are attached to cost sharing and applying the meters. I want to know if my rights as a grower were compromised. I mean rights to my water and my information, information about my pivots and my meters. Otherwise I'd wait and install them myself. I'd need more information.

Some others indicated that they were simply unable to afford the cost:

Unless they pay for it, I can't afford to put flow meters on every pivot I've got -- there's just no way. If they're going to require it, they need to pay for it.

Regarding the amount of cost-share necessary to induce farmers to immediately start using water-meters, given that they would be required to do so in three years, the results were as follows: Five of the 16 farmers indicated that they would need “at least 50%” cost share; one said 75% to 100%; another said 90%; five said 100%; and four did not answer the question. Based on responses of these 16 farmers, it appears likely that even with a regulatory requirement to adopt within three years and no cost share after this year, there would be considerable hesitancy among farmers to purchase meters this year, unless the cost share incentive covered all or a high proportion of the total cost of purchasing and installing meters.

IV. Summary and Conclusions

Summary

The goals of the research presented in this paper are two-fold. The first is to provide information about farmers’ knowledge of and attitudes about water meters. The responses indicate that generally, participants were unfamiliar with the use and application of water meters. Therefore, educational programs regarding the use of water meters should include basic information about water meters, such as the type of data that they provide, the units in which water use can be measured, and how meters can help to improve irrigation management. The responses also indicated that while the majority of farmers felt that water meters would have advantages, just as many perceived associated disadvantages. Even among those indicating that there may be benefits, there was considerable uncertainty about such benefits. This is typical of many agricultural innovations, and suggests the need for educational activities such as farm demonstration projects. For those farmers willing to *consider* meters, their willingness-to-pay was generally much less than the purchase price, which suggests that the use of subsidies will be a necessity for encouraging widespread voluntary adoption of water meters. Many of the participating farmers appeared to be unwilling to voluntarily adopt meters, even if subsidies were offered, primarily because of concerns about regulations.

The second goal of this research was to provide insight regarding the four propositions that have been suggested as relevant to the debate about water meters. The first proposition was: *P₁: Farmers believe that water meters will help them improve irrigation management.* The results indicated that only about half of the farmers surveyed believe that water meters will improve irrigation management. Many farmers already measure water use with rain gauges or system

charts, for example, and believe these to be sufficient. They consider the cost of installing water meters to be unnecessary.

The second proposition was: *P₂: Farmers, without incentives, will not voluntarily adopt water meters because of concerns about cost and regulation.* While regulation was found to be a widespread concern, this survey indicates that fear of regulation would cause about one-fourth of farmers surveyed to not want to adopt water meters. More important in limiting voluntary adoption were concerns about cost and doubts about the benefits of water meters.

The third proposition was that *P₃: Farmers believe that some other farmers will react negatively if they begin using water meters.* The responses in this survey indicate that this is not likely to be a major issue, with most farmers indicating that they thought other farmers would respond either positively or with indifference.

The fourth proposition evaluated was that *P₄: Farmers will voluntarily adopt water meters if appropriate financial incentives are offered.* Several farmers in the sample indicated that they would respond positively to cost-share. While the suggested cost-share varied, no one indicated a willingness to accept less than a 50% cost-share. About three-fifths of the participants, who specified a necessary amount, said they would require cost-share in the range of 75 to 100%, or a full 100%. Furthermore, some participants would be unwilling to voluntarily adopt water meters, regardless of the level of cost-share, either because of concerns about costs, doubts about the benefits of water meters, and/or fear of regulation.

Conclusions

Water-use measuring devices such as flow meters are common in some areas of the U.S. as a component of irrigation management practices. Water meters have several advantages. For farmers, they are relatively accurate indicators of how much water is being used. This is important for optimizing irrigation water use and crop yields, and may help in diagnosing irrigation system inefficiencies. Also, measuring, reporting, and analyses of water use data can provide guidance to policy makers, and be an important input to science-based hydrology and other models.

While water meters may enhance private and public water management, it has been the experience in other states that not all farmers respond positively to (some even strongly resist) the potential requirement of using water meters.

This research indicates that a relatively high proportion of farmers have little knowledge and understanding of meters and how they might be used. Participants in the survey shared their concerns about being required to install and use water meters, and their hesitancy to voluntarily purchase and install meters. Their concerns included costs, uncertainty about the need for meters and the potential benefits of meters, and suspicion of how meters might accelerate the government regulation of irrigation water use. Given these findings and the difficult financial situation of many farmers, it is not likely that there will be widespread voluntary adoption of flow meters, without substantial or full cost-share incentives.

Selected References

Barry, Thomas. (1987). The Development of Hierarchy of Effects: An Historical Perspective, in *Current Issues and Research in Advertising*, J. Leigh and C. Martin, Jr., eds. Ann Arbor, MI: The University of Michigan, 251-295.

Lavidge and Steiner (1961). A Model for Predictive Measurement of Advertising Effectiveness. *Journal of Marketing*, 25: 59-62.

Lynne, G.D., J.S. Shonkwiler, and L.R. Rola. (1988). Attitudes and Farmer Conservation Behavior. *American Journal of Agricultural Economics*. 70(1): 12-19.

Lynne, Gary D., C. Franklin Casey, Alan Hodges, and Mohammed Rahmani. (1995) Conservation Technology Adoption Decisions and the Theory of Planned Behavior. *Journal of Economic Psychology* 16: 581-598.

Malhotra, N.K. (1999). *Marketing Research: An Applied Orientation*. 3rd Ed. Upper Saddle River, NJ: Prentice Hall.

Rogers, E.M. and Shoemaker, F. (1971). *Communication of Innovations: A Cross-Cultural Approach*. 2nd Ed. New York, NY: Free Press.

Appendix A: Questionnaire

1. How important as a farmer do you think it is to know the amount of water that you use?
2. Why do you want to know this?
3. How do you currently collect information on the amount of water that you use? What do you do with this information?
4. Would you like to improve the accuracy with which you measure water use?
5. What do you think about using water meters for this purpose?
6. What is the first thing that comes into your mind when you think of water meters?
7. What do you know about water meters? (probe)
Show interviewee the information booklet about water meters
8. What do you think are the advantages of using water meters?
9. What do you think are the disadvantages of using water meters?
10. Do you think that most people would find water meters – and the information they provide - difficult to use? If yes, would this affect your decision to use water meters?
11. Do you think that the use of water meters would improve irrigation water management?
How certain would you say you are about this (very certain, certain, uncertain)?
12. Do you think that the use of water meters would lead to increased yields through changes in management from extra information?
How certain would you say you are about this (very certain, certain, uncertain)?
13. If you started using water meters, how do you think that other farmers you know would react?
14. Would you consider installing water meters within the next year?
If yes, what is the most you'd be willing to pay for it? What do you think would be a fair market price per water meter?
If yes, what is the main reason you would consider installing them? (Use laddering to probe).

Go to socio-demographic questions

If no, what are the things/issues that caused you not to want to install water meters within the next year?

Go to question 15

15. Suppose that having water meters was a requirement of participating in an incentive scheme, such as the irrigation land retirement auction held the last two years. Would this change your mind about installing water meters?
16. Here's a different situation. Suppose that because of the disputes with Florida and Alabama over water, the state decided it was going to require farmers to install water meters in 3 years time. However, if farmers started using water meters during the next year the state would cost-share the cost of purchase and installation.
Would you consider installing water meters this year if cost sharing were available?
If yes, what percentage cost share would be needed for you to install water meters this year?

Appendix B: Water Meter Booklet

(Reduced in size from the four page booklet made available to farmers participating in the survey)

The Propeller Flow Meter



- Various models available to fit most agricultural applications

This information is about only a single flow meter, other models and brands are available.

The Propeller Flow Meter

- Comes with an instantaneous flow rate and total rate indicators

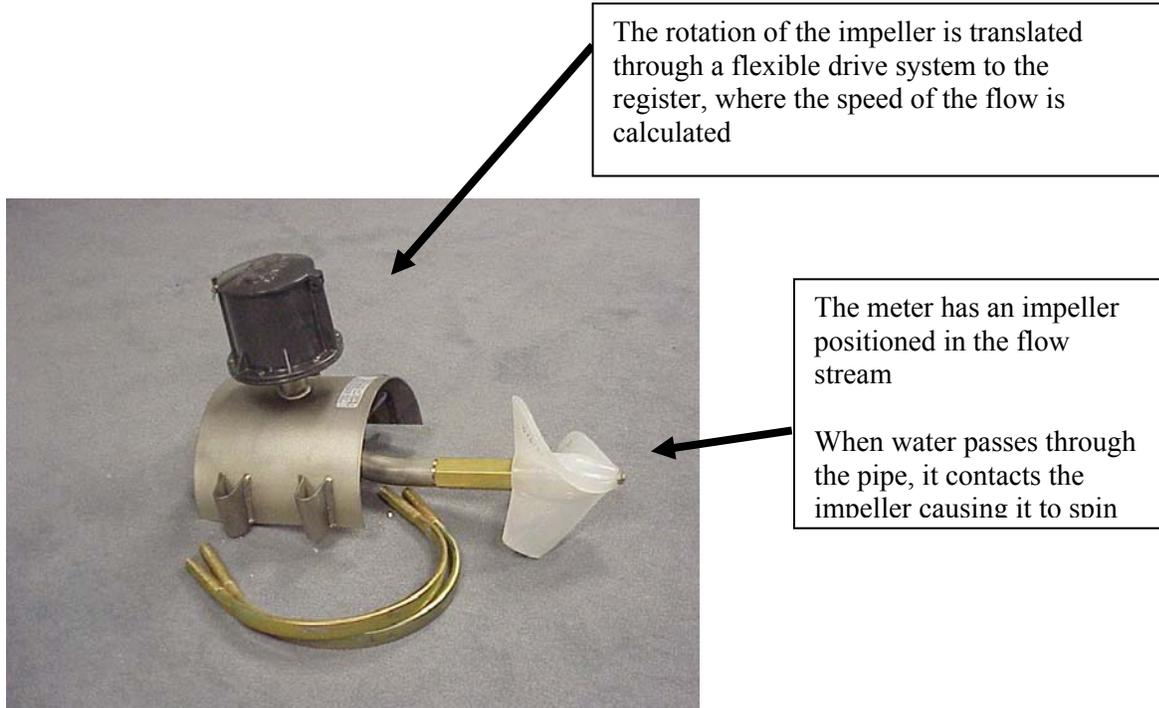


The Propeller Flow Meter

- High accuracy ($\pm 5\%$ of flow rate)
- Does not require electricity or batteries to operate
- Not affected by sediment or contaminants
- Various distributors on the market
- Propeller meter is most often used meter for agricultural water
- Typical cost of purchase and installation for an 8 inch meter is about \$800



How it Works



Benefits from Using Water Meters



An effective irrigation management tool:

- May help reduce irrigation costs
- Helps prevent over or under irrigation, which can increase yield and reduce plant disease
- Will let you know when there are problems with your equipment
- Helps reduce leaching of chemical fertilizers into the ground
- Environmental benefits from reducing unnecessary water usage