Identifying Market Segments for Technology Adoption[1]

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Abstract

In the 1940s it was first noted that the adoption of agricultural innovations tended to follow a normal type distribution. Rogers (1964) articulated this process and classified farmers into five groups according to their speed of adoption: innovators, early adopters, early majority, late majority and laggards. Further, Rogers noted that speed of adoption tended to be a function of wealth, age, education, risk preference, sensitivity to social pressure and organizational memberships. This adoption-diffusion model has important marketing implications. If the model holds, the optimal strategy for encouraging adoption is to develop a marketing strategy that will encourage the innovators and early adopters to being using the product, who will then influence others to imitate them, as they tend to be opinion leaders in the community. However, the adoption-diffusion model was originally developed to explain the adoption of technologies such as hybrid corn, where adoption is relatively costless. Modern technologies can be quite different, involving sizeable expenditures in equipment, infrastructure or human capital, and/or involving large additional commitments of time. In this study, the relevance of Rogers (1964) adoption diffusion model is investigated for a new modern technology "Irrigator Pro", which is a computer based irrigation-scheduling software developed by the US Department of Agriculture. For this technology, the market segments with the greatest propensity to adopt Irrigator Pro were found to be different to those that would be predicted using the traditional adoption-diffusion model.

1. Introduction

There has been considerable debate in both economics and sociology about the factors that explain technology adoption, particularly in the area of agriculture, but also in other areas such as marketing of consumer products. Economists and sociologists agree that many different factors affect adoption decisions, although there has been disagreement over the relative importance of economic and sociological factors (Andrew and Alvarez 1982). Economists have historically emphasized factors such as profitability (eg Griliches 1957) while sociologists have emphasized the importance of interaction between farmers (Bradner and Straus 1959).

One of the first models developed to explain the adoption process for agriculture was the adoption-diffusion model (Rogers and Shoemaker 1971). Under this model, farmers are believed to go through five stages before fully adopting a new technology. First comes *awareness* when farmers learn about the existence of a new technology. Next, farmers go through a stage of *information gathering*. If interested, they will collect more specific information about the technology. After this information is

[1] Paper presented at the Australian Agricultural and Resource Economics Society Conference, Coffs Harbour, February 2006.

collected, the farmer goes through an *evaluation* stage, where the farmer considers whether adoption the technology is worthwhile. This leads to the *trial* stage, where the farmer tests the applicability of the technology. Finally, if the trial is successful, is the *adoption* stage where the farmer starts to use the technology on a larger scale.

While farmers are believed to go through these stages sequentially, some farmers are believed to reach the adoption stage more quickly than others. Ryan and Gross (1943) first observed that awareness and adoption of agricultural innovations (eg hybrid corn) followed bell type (or normal) distributions (Ryan and Gross 1943). Ryan and Gross, who were sociologists, explained this process of adoption by what they described as an interaction effect. According to Rogers (1964), this is a process through which farmers who have already adopted a new technology influence those who have not yet adopted. Using data from a number of independent studies of new product adoption by farmers, Rogers (1964) divided different farmers into groups according to how quickly they adopted new technologies. Innovators are the first to adopt, and comprise about 2.5% of the farmer population. These are followed by early adopters (13.5% of the farm population), the early majority (34%), the late majority (34%), and laggards (16%). The socio-demographic and attitudinal characteristics of the people in each of these groups are summarized in Table 1. Earlier adopters tend to be wealthier, more educated, more established, more risk preferring, more immune to social pressure and have a greater range of contacts where they can acquire new information.

An important implication of the adoption-diffusion model is that more rapid adoption of new technologies can be encouraged by directly targeting and promoting innovators and early adopters. These groups are central to encouraging adoption amongst the majority of farmers. If these groups adopt a new technology and find it satisfactory, they will effectively market the technology to other farmers through their interaction with them. When developing a marketing strategy (such as the features of the product, setting of price, methods of promotion and distribution), effort should therefore be given to tailoring the product to the preferences of, and reaching, the earlier adopters. However, most technology adoption studies have focused on identifying the preferences of all farmers rather than just earlier adopters. For example, in the studies by Purvis et al (1989) and Cooper and Keim (1996), both of which examined incentives need to encourage adoption of best management practices, the focus was on examining willingness to accept of *all* farmers rather than just the earlier adopters.

Part of the explanation for this alternative focus is the differing perspective in sociology and economics on what caused farmers to adopt in the first place. For sociologists, the process of interaction is central. Many economists, however, have tended to argue that adoption can be explained through profitability. Griliches (1956), for example, showed that the speed and level of adoption of a new technology is strongly related to economic profitability. Farmers in a region are more likely to adopt a technology to a greater extent and earlier if it will be more profitable to do so. Some researchers prefer to take the middle ground, noting the importance of both economic and sociological factors. As Andrew and Alvarez (1982) conclude, “When studied, profitability and the interaction effect can provide evidence of the joint impact of social and economic factors on the adoption process”.

Table 1: Farmer Adoption Groups

	Innovators	Early adopters	Early majority	Late majority	Laggards
Personal characteristics	Most educated, younger than average, highest net worth	Higher than average education, younger than average, not necessarily younger than innovators, larger operations	Slightly above average education and age, medium net worth	Less educated than average, older than average, less than average net worth	Least educated, oldest and lowest economic status
Risk preferences	Can afford and do take calculated risks	More willing to take risks than average farmer	Must be sure an idea will work before adopting. Has more limited resources than earlier adopters so can't afford to make poor decisions	"Sceptical", overwhelming pressure from peers needed before adoption occurs	Most risk averse of all farmer groups
Position in the community	Respected for being successful, but sometimes ridiculed by conservative neighbours	Provide a disproportionate amount of community leadership and are respected as a good source of new farm information by neighbours	Generally not elected leaders, but may have informal leadership due to sound judgment. Lots of people talk over ideas with them – which is a source of pride. May look to early adopters for ideas.	Take few leadership roles and don't participate in many activities outside of the community.	Semi-isolated
Attitude to social norms	Largely ignores neighbourhood pressure	Willing to be opinion leaders	Highly value the opinions their neighbours and friends hold about them.	Sceptical of new ideas, need overwhelming peer pressure before adopting new ideas	"Traditional", oriented to the past
Organizational memberships	Frequently belong to organizations at the county, regional, state or national level. Often have informal contacts outside community.	Participate more than average in community groups (eg churches, PTA etc) and in govt extension activities.	Less active in formal groups than innovators or early adopters, but more active than later adopters. Do attend extension meetings and farm demonstrations.	Participate less actively in formal groups, but form the bulk of membership.	Participate least actively in formal groups, coops and govt agency programs. Many are suspicious of extension agents and agricultural salesman.

Source: Rogers (1964), Rogers and Shoemaker (1971)

When considering the relative importance of social and economic factors on adoption, it is worth considering the context that led to the adoption diffusion model being proposed. As already discussed, the adoption diffusion model was initially developed in the 1940s and 1950s to explain the adoption of new technologies, such as hybrid corn. Hybrid corn is a fairly unique technology as it produces significant benefits, yet its adoption is relatively costless: no additional effort or new training, equipment or infrastructure is needed. In this context, sociological variables such as the value placed on the perspective of other farmers, attitudes towards risk, education, age, and being a full-time farmer, are likely to be particularly important. Indeed, there is a lot of empirical evidence in the literature demonstrating the importance of these variables in explaining adoption (eg Ervin and Ervin 1982, Rahm and Huffman 1984, Lynne et al 1988, Caffey and Kazmierczak 1994, Zepeda and Castillo 1997, Soule et al 2000, Khanna et al 2001, Soule 2001).

However, in other contexts, other non-sociological variables may be relevant. For instance, consider the case of new technologies that require sizeable expenditures in equipment and infrastructure. In these cases it has been predicted and demonstrated that the probability of adoption is a function of farm size, capital availability and perceived financial control (David 1969, 1975, Caffey and Kazmierczak 1994, Lynne et al 1995, Zepeda and Castillo 1997 and Soule et al 2000). Or where the adoption of new technologies requires the acquisition of new skills, such as the use of GPS positioning tools, having existing competencies in this area may explain adoption behaviour (Khanna et al 2001). Thus there is reason to believe that the adoption of new technologies may not always follow the bell-shaped curve predicted by the adoption diffusion model. If correct, this has important implications for marketing strategy, especially if the innovators and early adopters have different characteristics from what is predicted by the traditional model, and if the traditional "diffusion process" does not spontaneously lead to widespread adoption across the market.

To investigate these issues, we explore the relevance of the adoption diffusion model for a new modern technology: "Irrigator Pro", which is a newly-developed irrigation scheduling software developed by the US Department of Agriculture. The technology is explained in greater detail in Section 2, and the survey methodology is overviewed in Section 3. The qualitative results are presented in Section 4, and implications for the marketing of new agricultural technologies are discussed in Section 5.

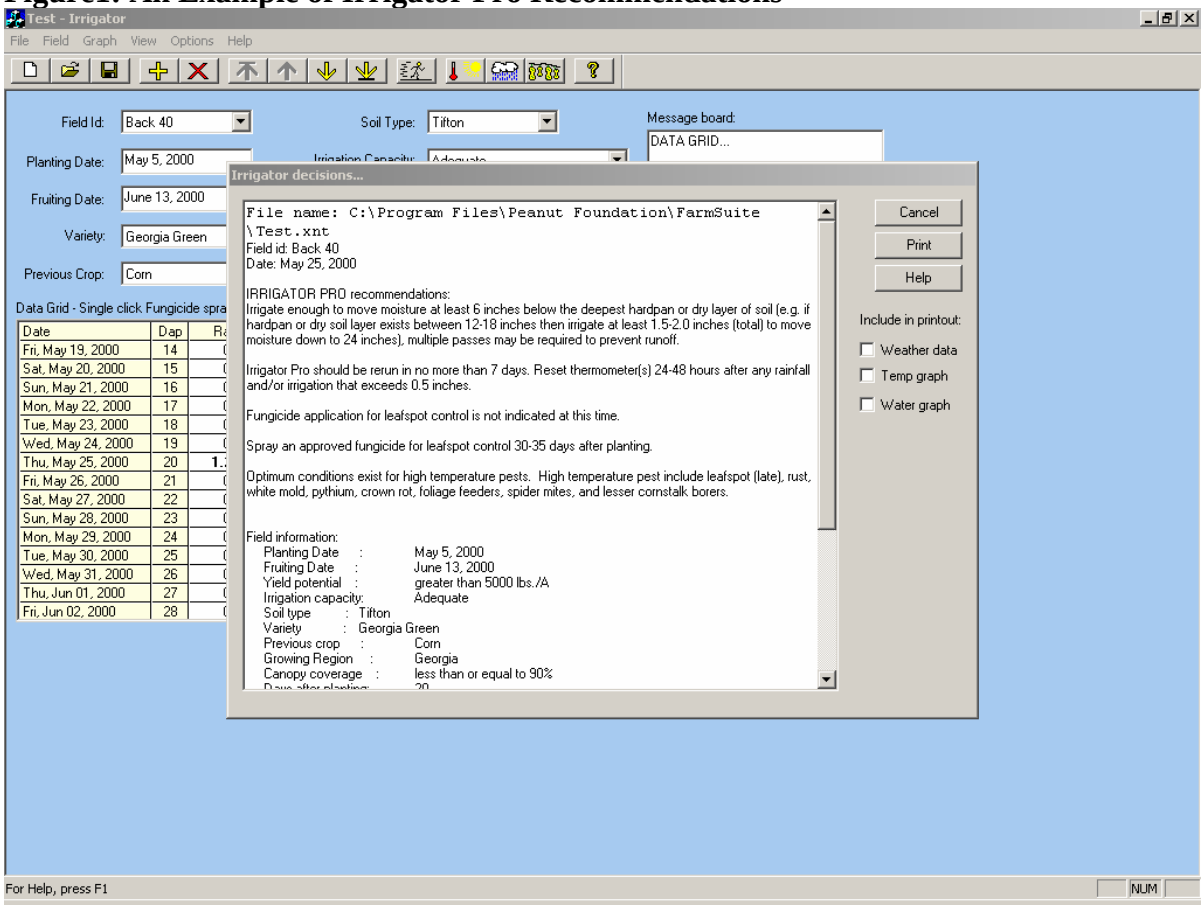
2. A Modern Technology: Irrigator Pro

Irrigator Pro is a computer program designed to help farmers make better irrigation and pest management decisions. The aim of this system is to deliver to farmers increased economic returns via improved yields and reduction in the risk of plant disease, reduced use of chemicals and environmental impact through reduced water use.

Irrigator Pro is used primarily to help schedule irrigation and herbicide applications. It uses information from USDA trials and other scientific studies about optimal irrigation practices. Irrigation is scheduled so that soil moisture is maintained at levels which promote optimum crop growth rates, pests are controlled and the need for fungicides is reduced.

In terms of what's required from farmers, Irrigator Pro initially requires the farmer to supply initial data on crop variety, soil type, irrigation capacity, yield potential and growing region. In addition, it requires up-to-date information on rainfall, soil temperature, weather and past irrigation or fungicides applications will need to be entered. Irrigator Pro requires that rain gauges and stem thermometers are used in each field to collect this data. Irrigator Pro works by asking the user a series of questions concerning their crop and the weather conditions. Once these questions have been answered the program produces a report outlining when and how much irrigation is needed, as well as advice on pest control and the use of fungicides (see Figure 1). Irrigator Pro can be used before planting up until the end of the harvest. Information should be regularly entered into the system for more precise recommendations.

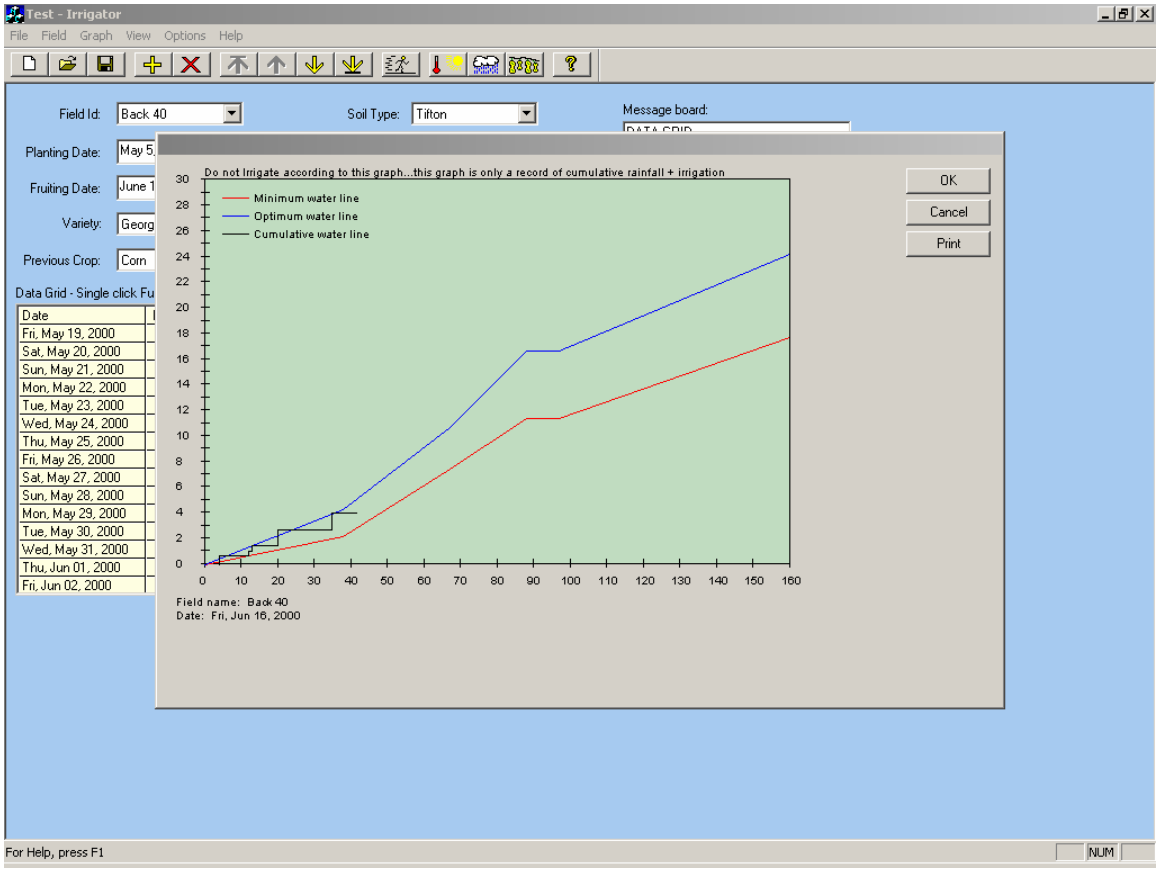
Figure1: An Example of Irrigator Pro Recommendations



An advantage of Irrigator Pro is that farmers can generate decisions for future dates, which allows for better-planned irrigation. Once a decision has been generated Irrigator Pro will advise the user on whether to irrigate or not; when to re-run Irrigator Pro; the amount of irrigation needed; the fungicide application that is recommended and a warning of possible problems with high or low temperature pests.

Irrigator Pro also uses water and temperature graphs to show farmers how well their irrigation schedule has been at keeping soil temperatures and irrigation at the optimum level. These graphs display minimum and optimum water and temperature ranges while providing a cumulative history of past irrigation (see Figure 2).

Figure 2: Graph Showing how Actual Irrigation Compared to Optimal Irrigation



3. Survey Logistics and Sample Description

In-depth personal interviews were conducted with 30 irrigation farmers in the Flint River Basin between May and August 2002. A copy of the questionnaire is presented in Appendix A. All interviews were conducted by a trained interviewer who has a background in farming and is from southern Georgia. Recruitment of farmers was based on a non-probability sampling procedure. Lists provided by the USDA and the Flint River Water Planning and Policy Center were used to recruit farmers. The use of non-probabilistic sampling procedures for qualitative research is standard practice (Malhotra 1999). Interviews lasted about 1.5 to 2 hours, and respondents were given several incentives to participate.

Regarding the socio-demographics of respondents, the average age of farmers was 47.6 years (standard deviation 9.4 years). The majority of farmers were college educated (18 out of 30). For the majority of farmers (26 out of 30), farming was their main source of income. The average farm size was 1895 acres (standard deviation 1220 acres). The main crops grown were peanuts (92.9% of farmers), cotton (82.1% of farmers), corn (60.7% of farmers), pecans (25% of farmers), cattle (14.3% of farmers) and wheat and other small grains (14.3 % of farmers). All of the farmers surveyed used groundwater for irrigation, and 17% of farmers also used surface water. On average farmers irrigated 81.5% of their cropland (standard deviation 15.3%).

4. Qualitative Results

Innovators and Early Adopters

In analyzing the qualitative data we begin by considering the attitudes towards Irrigator Pro of those that Rogers (1964) would suggested tend to be innovators or early adopters. In terms of personal characteristics, these are those who have a higher income, are more educated and younger than average. In addition, the effect of other factors on farmers' likelihood of adopting Irrigator Pro such as risk attitude, position in the community and sensitivity to social norms are examined.

About a quarter of the farmers surveyed had farms that were larger than 2500 acres, and therefore could be considered to be higher income farmers. The majority of these farmers were tertiary educated, with five out of seven completing at least two years of college or a higher degree. The average age of these farmers was 46 years, with only one farmer over 55 years of age.

Before any questions about Irrigator Pro, in the survey, farmers were initially asked about what methods they currently use to make irrigation decisions on their farm. Several different methods are used. A few of the farmers use their experience:

> *We just do it by walking the fields checking the crops, looking at the moisture to determine whether we need to run our irrigation system*
>
> *Just the past history of the field and just the knowledge of working with irrigation in the past…I just look at it and if I think it needs it; I go by sight, I guess*
>
> *Experience*

However, two of these seven farmers currently use irrigator pro, with one relying on the help of a consultant to use it. Another of these farmers has trialed an irrigation scheduling program (different to Irrigator Pro) but didn't like it and now relies solely on experience. The last of these farmers makes use of a consultant, but does not use any scheduling software. Thus a little less than a third of farmers in this group of wealthier farmers are currently making use of scheduling software.

Farmers were then shown a demonstration of Irrigator Pro and then asked further questions. Farmers were first asked what they considered the advantages and disadvantages of the program. As expected, advantages included reduced water usage and fungicides, and increased yields. In terms of disadvantages of using Irrigator Pro, the most often mentioned theme was the time required to use the program:

> *Taking the extra time to enter the information*
>
> *…in my situation I don't have a whole lot of time and I definitely am not one on doing any kind of paper work. I'd rather take a whipping than sit down at a desk and write something out or try to put something on a computer…I don't*

doubt that it wouldn't probably help me out, but…in my situation with limited labour and limited time…

There needs to be something on the front of that computer every time it turns on

Having to get and record those temperature readings daily takes a lot of time

Other disadvantages mentioned include the possibility of making mistakes, and the fact that it is *a radical change from the way I thought*. While considering disadvantages, farmers were also asked whether they thought most people would find Irrigator Pro difficult to use. A third person technique was used for this question to encourage respondents to be honest when answering this question. Four of the seven farmers thought it would be straightforward, but the three oldest farmers in this group all noted difficulties. For two of these farmers it was the complexity involved in using a computer program, while for the remaining farmer it was the difficulty involved in getting the correct information.

To further clarify farmers' assessment of the advantages of Irrigator Pro, farmers were next asked about how certain they were that Irrigator Pro would improve irrigation water management and lead to increased yields. The purpose of this questioning was to determine how risky they thought it was to use Irrigator Pro. Some farmers thought there was certainty about the benefits of using the program:

A better job is being done. There's no doubt.

No doubt

I am certain, the software tells you what is going on and what you need to do.

However, most were more circumspect, with several indicating a need to trial the program first:

I think you have to go back and look at it as a trial and error thing. I have to learn how to use it…It's all a big step. I think over a year or two, maybe three years when you get used to working with it.

I think it could, you know, if it was used right

I don't think so, not for this farm, uncertain

I wouldn't know until I tried, but from the data you're telling me yes I would

Finally, farmers were asked whether they would consider using Irrigator Pro within the next year, or would get a consultant to help them use it. As mentioned earlier, one of the seven farmers in this group is already using Irrigator Pro. Of the remainder, one farmer said they would use the program and two others said that they would either consider using the program or would like to trial its usage. Only two farmers said that they definitely would not use the program, citing the difficulty of collecting data for the program, age and computer literacy. It is also of interest that the two

farmers that don't want to use the program have a university education, while the two farmers within this group who only have a high school education are willing to trial the program. Thus generally it appears that the younger and more computer literate farmers are those within this group are those most likely to use the program, but use of the program is not related to higher education:

> *No. Just the process of going and collecting the data and putting it in the computer. The time involved…and the fact that I don't like fooling with stuff like that. Now you know, if it was [farmer's name]…he's a computer guru and I think he enjoyed playing on the computer putting all that stuff in, but that's just not me.*
>
> *No…The things change with the generations. When I started farming, chemicals were coming in and daddy turned that right over to me. He said you look after it he wasn't keeping up with it. Well computers and all that are coming and in and that's his project [his son], not mine.*

Early Majority

In the next group there are twelve farmers, who have a farm of at least 1000 acres and are less than 60 years of age. The average age of these farmers is 44 years, so it is similar to the previous group. The average farm size for this group is 1530 acres, which can be compared to 3400 acres for the previous group. Seven of these farmers have been to university, and all except for one of these farmers is computer literate.

These farmers were asked the same questions as the previous group. In terms of current methods of managing irrigation, about half used advice from the extension service, and half used their own judgment. Only one of these farmers has currently used Irrigator Pro. Here is a sample of their comments:

> *Extension gives us some pretty good guidelines to go by as far as how much water a week a crop needs at that stage*
>
> *I usually go mainly be the Extension Service and dates they use as the crop requires the most water…*
>
> *We use university data regarding water requirements on a per week basis for the crops that we grow. They have scale models to tell us how much water we need for each of these crops to achieve optimum yield at each stage of growth.*
>
> *Not really a policy, it's just using judgments from past history. We do try to water heavy and less often.*
>
> *We have an idea of what our needs are on different crops at different stages of growth and we try to maximize our return on our water that way.*

Regarding the strengths of Irrigator Pro, this group noted similar advantages regarding reduced water and fungicide usage and improved yield. In addition, they also noted

that it would help in monitoring their crops and in improving the timing of their irrigation:

> *When to irrigate at the right time, and when to spray and not to spray*
>
> *Probably the biggest strength is to help you head off waiting too late to start irrigating, especially if you got a big field, we have a tendency to wait and see the peanut stressing before we begin to water.*
>
> *…it would help me or someone monitor my crop data, rainfall, temperature, keeping a record of when I irrigate when I used fungicide treatments*

In terms of the disadvantages of Irrigator Pro, the main concerns of this group related to the possibility of data being entered incorrectly or the program giving incorrect advice. Only two of the farmers in this group suggested that time might be an issue, and both of these farmers indicated that they could get consultants to run the program for them.

> *Taking time to do it…Just being dedicated enough to take the data down and to do what it says. Use your consultants; I think that's the best way to go.*
>
> *Time to learn it correctly…I hire a consultant now to help me with cotton and peanuts and…I think it would be a management tool that would work into a consultant's operation a lot better than an individual farmers.*
>
> *…maybe not getting the data in correctly*
>
> *…not taking the time to put the inputs in and do it in a proper manner*

When asked about whether they thought farmers would find Irrigator Pro difficult to use, two thirds of these farmers thought it would be easy to use. A couple of farmers thought that farmers who were lacking in computer literacy would struggle, but they did not consider it to be an issue for them. However, the issue of the time required to collect data was brought up by three farmers. One of these three farmers suggested it would be straightforward to use a scout to collect the data, however another who was opposed to either using scouts or consultants on his farm thought it would be an obstacle to its usage.

These farmers were also asked, similar to the farmers in the previous group, about how certain they were that Irrigator Pro would improve irrigation water management and lead to increased yields. Generally, the farmers in this group were more inclined to trust the technology, with about two-thirds being certain or very certain that these benefits would be achieved. Only a few had some doubts:

> *I do not know if I could say for certain whether it would lead to increased yields because I have not seen it compared to the way I've been doing it normally*
>
> *I don't know, I am not sure*

I would be uncertain, we don't know for sure when the water would come and we can't control the temperatures and they have the most influence of anything…

In terms of likely adoption, all of the farmers in this group said that they would be likely to consider using Irrigator Pro next year, or use a consultant to help with the software. This can be contrasted with the previous group of farmers with larger acreages where only about half of the seven farmers said they would either use or trial using the program next year. It appears that farmers in this group are more motivated by economic need. They have smaller farms than those farmers in the previous group, and need to maximize the profitability of their farms, even if it requires additional time. They cannot afford to ignore technological advances. Note the following comments:

[With] the economics right now of agriculture, I think, you have to have somebody to do it

We don't have any margin of error. This would help fine-tune your whole system….After you got started this would keep you right on track. You have something besides your gut feeling and the feeling of dirt….This really could be a tool that you could know what you were doing.

To increase the yield. I didn't feel like my yields were adequate and this seemed to be a way of improving, plus it gave me some new information

To just fine tune the operation, to make more money on the bottom line and to conserve resources.

Timely irrigation, yield increase. At the same time it could save me money too.

Improve my bottom line, whether it is saving money or increasing yield.

Late Majority and Laggards

The final group of nine farmers in the sample is categorized as either late majority or laggards. These farmers have farms smaller than 1000 acres and/or are more than 60 years of age. The average farm size for this group is about 525 acres[2], and the average age is 54 years; thus the farmers have much smaller farms and are generally much older than the previous two groups. The education level of this group is fairly similar to the previous group, with about a third of farmers only having a high school education.

As might be expected with the farmers in this group, there was a much greater reliance on personal judgment and past experience when making irrigation management decisions. Most of the farmers would consider the type of crop they had, the soil type, the stage of the crop, whether the crop is stressed, and weather patterns. None of the farmers currently use Irrigator Pro or any other scheduling software, and only one farmer makes use of a consultant. The prior awareness of Irrigator Pro was very low for this group, with only four of the farmers having heard of it and none of them know anything substantive about the program. Note the following comments about current methods of irrigation management:

> *Weather patterns, conditions at the time, what kind of past conditions…looking a the weather reports, conditions of the crop and the different stages of crop development*
>
> *If it's hot and dry, crank it up. If it wilts, crank it up. I try to wait as long as I can.*
>
> *Looking at the crop…it's always been if you thought you needed to water, you needed to water.*
>
> *Years of experience, but mostly common sense*
>
> *Well we just pretty much utilize the condition of the crop and of course I don't use the scientific methods of what kind of moisture we got in the soil, we just rely on past experience and a lot of looking in the crop. I use a crop consultant and he tells us a lot about how much and when to water, together with what we learned from experience.*
>
> *We go out and check the soil and check the plant and try to start irrigating before the plant goes into stress. Whatever – corn, cotton, peanuts – we try to get a day or two ahead of the water because if we get a day or two behind the plant's going to get into stress and it's going to cost.*

As with the other two groups of farmers, questions were asked about the advantages and disadvantages of Irrigator Pro. Several farmers commented that they thought it would take the "guesswork" out of irrigating and improve decision making, especially

[2] Note: two of the older farmers did not report their farm size, so it is possible that the average farm size for this group is larger than this number.

relating to the timing of irrigation. Others suggested that there may be cost reductions and reduced water use.

> *It helps you take a lot of the guesswork out of making decisions that concern your profit line and yield potential. We're so used to watering all the time out here that we might be watering more than we should.*
>
> *For one thing you'll keep a daily record of what's going on in the field, and it will tell you when to water when not to…keeps you from over irrigating or under irrigating.*
>
> *I can see how it would save water if it worked like it was supposed to work*

However, there was less certainty amongst farmers that it would improve water management and lead to increased yields. Only four of the nine farmers thought it would improve water management and increase yields, and four of the remaining farmers were uncertain about the effect using the program would have on yields. This indicates that the use of this program may have a lower expected benefit than with the other groups.

In terms of disadvantages of using the program, two farmers noted the time involved and four farmers noted the potential for user errors. Again, time as an issue was mentioned less frequently than with the first group. Concern about user errors was mentioned more frequently with this group:

> *Taking time to do it, because most of the time you ain't got time to do what you normally got to do.*
>
> *My weakness would be making sure I put all the data into it…*
>
> *Too much time to enter data*
>
> *I think the weaknesses of it would be in the man operating it like any other thing.*
>
> *The longer it has been in use the more efficient you'll get with it, and I would say right now that my biggest problem would be learning how to use it.*

Overall, farmers in this group did not thinking farmers would find the program difficult to use. Most thought that farmers would be able to use the computer program, and several commented that they could incorporate the extra work required into their existing farming practices. However, others did have a different perspective and noted the difficulty attached to having to use the program every day.

> *Farmers are going to be out in the field checking everything almost daily anyhow. It's not going to take just a little time to take a reading or look at the temperature and all that.*
>
> *You just got to take the time to read the instruments and keep up with the data and enter in the information.*

It looks fairly simple

Not difficult to use, maybe difficult to discipline themselves to use it.

I don't think it would be hard to use. The daily thing might be hard, to check it daily.

I think it's just a matter of deciding that you want to do it

Generally there was a lower willingness to consider trialing Irrigator Pro than with the farmers in the previous groups. Three of the nine farmers said they would consider using Irrigator Pro next year, and two others indicated that they may use a consultant to help with the program. The reasons given for not using the program included not having enough acres, being too busy, and difficulties collecting the data. Farm size and computer literacy appear to be determinants of willingness to use the program. Of the farmers that would not consider Irrigator Pro next year, three of these farmers had very small farms (ranging from 50 acres to 650 acres), and four of these farmers did not know how to use a computer.

I just don't have the acres and stuff for a consultant

Hell, we've got so much going on right now I can guarantee there's some data that wouldn't get entered.

If you would use a scout it would work good, but he isn't going into your field every day.

5. Discussion and Implications for the Marketing of New Modern Technologies

The goal of this paper has been to investigate the relevance of the adoption diffusion model for a modern computer based technology involving irrigation scheduling. If correct, the adoption diffusion model would predict that those most likely to initially adopt this technology would be those with higher average wealth, are risk takers, have better than average education, who were leaders in their community, less sensitive to social norms and have access to more up to date information.

However, technologies are not homogenous. While it might be appropriate to characterize farmers with these socio-demographics and attitudes as being more likely to be innovators or early adopters, it doesn't mean that they will be innovators and early adopters for all products. Some products – such as Irrigator Pro – because they are time consuming may be less suitable for use by wealthier farmers with larger acreages (and those more able to take risks) who have less necessity to increase profit and are relatively time poor. As one farmer commented when asked about the type of farmer he thought would be most likely to use Irrigator Pro: "They would not be extremely large in number of acres". Indeed the results confirmed this: the farmers most likely to adopt the technology were those with an average sized farm. They had

the time to do so (because they were managing a smaller farm) and the motivation to do so (as the profitability of a smaller farm is generally less).

Education also did not appear to be a good predictor of adoption of Irrigator Pro. Many farmers who had a university education were unwilling to trial the product while some farmers with only a high school education were willing to adopt the software. What appeared to matter more was having the requisite computer skills, which has been found in previous studies (Khanna et al 2001).

Nonetheless, some predictions of the adoption diffusion model appeared to be sound. The probability of adoption appeared to be related to age, with older farmers generally less willing to trial Irrigator Pro. Unwillingness to take risks, because of fear of the consequences of financial loss, also appeared to be a predictive variable.

These findings have some significant marketing implications. It appears that those most likely to use this particular technology are not those who would generally be considered to be innovators or early adopters based on their socio-demographic characteristics. Rather, those most likely to use the product are those who would generally be classified as early majority. This demonstrates that relying solely on the predictions of the adoption diffusion model when developing a marketing strategy can be misguided. Target marketing should not always focus on those farmers with a higher sociodemographic status because they are more likely to adopt a product and, as opinion leaders, influence those around them to also trial a product. If this were done in this instance, it is possible that there would be relatively low initial uptake (because the product is less suited to high-end farmers) and adoption would be slower overall. An alternative strategy would be to attempt to first identify the target market for the product and then initially promote the product to those most likely to adopt the product within this target market (in this case farmers with average sized farms, who are younger and computer literate).

This implies quite a different method of product promotion and distribution. Those in the early majority generally make less use of extension and are less connected other agricultural organizations than those with a higher socio-demographic status. This implies that reliance on these standard distribution channels may not be appropriate for this sort of technology. On-farm demonstrations – such as was used in this study – or other forms of direct marketing may be more appropriate for encouraging product adoption.

In summary, the appropriateness of using the adoption diffusion model for marketing decisions appears to be a function of product characteristics. For some products, such as hybrid corn or conservation tillage, the model may be a good predictor of consumer behaviour. However products and services differ, and the groups or segments within the community that are most likely to adopt the product are also likely to be different. For some products, such as Irrigator Pro, those most likely to use the product may not be those usually considered to be innovators and early adopters. Hence, in cases such as Irrigator Pro the predictive power of the technology diffusion model is likely to be diminished. This indicates a need for the use of qualitative and quantitative research to understand the attributes of a product and to whom the product will most appeal when developing a marketing strategy.

Acknowledgments

This research was in part conducted while the author was Visiting Assistant Professor, Environmental Policy Program, Georgia State University. The contributions of Nancy Norton, Virgil Norton, David Eigenberg, Marshall Lamb and Ron Cummings are gratefully acknowledged. Thanks to John Cooper for his assistance in the writing the section on Irrigator Pro.

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