ESTABLISHING A PROCESS TO IMPROVE IRRIGATION AUTOMATION

Final Report

July 1998

Roger Standen and Greg Roberts

Department of Natural Resources and Environment

Institute of Sustainable Irrigated Agriculture, Cobram, Victoria

Establishing a Process to Improve Irrigation Automation

Best Irrigation Practice Benchmarks: A Comparative Analysis (1995-1998)

July 1998

Department of Natural Resources and Environment
Institute of Sustainable Irrigated Agriculture, Cobram, Victoria

National Program for Irrigation Research and Development

Natural Resources and Environment

Introduction

Irrigated dairying is a major farming activity in the Murray Valley Irrigation Area (MVIA), in north-east Victoria, contributing greatly to this State's economy. Most of the dairy farmers in this area flood irrigate their pastures. For better pasture quality and quantity, efficient irrigation is vital. The project entitled *"Establishing a Process to Improve Irrigation Automation,"* realising the importance of irrigation for the dairy industry, has defined some key best irrigation management practices for the area. The practices followed by farmers in regard to these locally identified best irrigation practice benchmarks were assessed during 1995, before the implementation of the project and again re-visited during 1998, after the implementation of the project. The comparative results during the two study periods are presented below.

The changes recorded during these two study periods are not solely due to the implementation of this automation project as there were other irrigation related activities being carried out in the study area such as those related to whole farm planning and dairy effluent management. However, this study could provide a measure of the general trend in irrigation management practice change by farmers in the area.

During 1995, 83 farmers in the MVIA were chosen at random and were personally interviewed. During 1998, 76 of these 83 farmers again provided their responses.

What are the best irrigation practice benchmarks?

Best irrigation practice benchmarks are indicators to measure irrigation performance. Four indicators and associated benchmarks were developed by a group of farmers and irrigation advisory staff from the Department of Natural Resources and Environment (DNRE) and Goulburn Murray Water (G-MW). Among these four indicators, only the first three were used. The fourth indicator which describes the amount of water used per hectare per irrigation had many inherent errors associated with the estimation of irrigable area, period of irrigation, speed of wheel, and flows supplemented by bores and effluent pumps. For this reason application rate of water by farms is not reported as a benchmark criteria.

Indicator 1: Irrigation System Capability

Benchmark

> *The irrigation system should have channels and channel structures capable of carrying the* ***full flow of water available to the farm meter outlet****. Normally, this is a Small Meter Outlet (SMO) operating at 10 or more revolutions per minute (supplying 5 or more ML/d) and a Large Meter Outlet (LMO) operating at 8 or more revolutions per minute (supplying 12 or more ML/d).*

It is important to be able to get the full flow of water from the meter outlets. The flow rate (ML/d) available determines the overall irrigation duration. The time taken to irrigate with the full flow of water is always less than the time taken to irrigate if the outlet is not running at its full flow level. Particularly in lighter soil types, the availability of a full flow of water enables quick irrigation to an area which minimises the chance of deep percolation.

Indicator 2 Drainage Efficiency

Benchmark

> ***Excessive irrigation water drains off without ponding or backing up on bays.***

This criteria deals with farm drainage efficiency. Irrigation water ponding or backing up in drains onto bays indicates poor drainage systems. Poor drainage systems can lead to waterlogging of the pasture, thus reducing pasture quality and quantity, and resulting in an increase in weeds.

Indicator 3. Off-farm Drainage

Benchmark

> ***No irrigation water leaves the farm.***

This criteria relates to efficiency of water use on farm, as well as off-farm environmental issues associated with nutrients and salts entering district waterways and affecting downstream users.

All these parameters encompass many specific details, but were seen as being measurable and understandable by farmers when expressed as above.

Assessment in relation to the best irrigation practice benchmarks

Each of the above mentioned parameters were assessed through the survey to determine dairy farmers performance against the benchmarks during the two study periods.

1. Irrigation system capability

Table 1 reveals that 45 % of the farms during 1995 and 49 % during 1998 were in a position to carry full flow of water through all of their outlets. The rest had at least one outlet which was not carrying water with 10 revolutions through SMOs and 8 revolutions through LMOs. Considering individual meter outlets (Table 2), 54 % of the SMOs in 1995 and 63% in 1998 were carrying 10 or more revolutions per minute. Similarly, 62 % of the LMOs in 1995 and 66 % in 1998 were carrying 8 or more revolutions per minute.

Table 1. Percent of farms with better than or full flow of water through all outlets

Revolutions per Minute	First Round Survey % of Farms	Second Round Survey % of Farms
Better than full flow of water (10 revs. and more for both SMOs & LMOs)	25	26
Full flow (10 revs. through SMOs and 8 revs. through LMOs)	45	49

Overall, 58 % of the meter outlets during 1995 and 65 % in 1998 were running at the full flow level. This provides a broad picture about the capability of on-farm irrigation systems during two study periods. Tables 1 and 2 indicate a general positive shift in obtaining the full flow of water through outlets during 1998 compared to 1995.

Table 2. Percent of meter outlets with full flow of water

	First Round Survey (% of outlets)	Second Round Survey (% of outlets)
10 revs. and more through SMOs	54	63
8 revs. and more through LMOs	62	66
SMOs and LMOs running at the full flow level	58	65

2. Drainage efficiency

Farmers were asked "how long water ponds at the bottom of their bays?" They were asked to give ponding times for lasered bays and non-lasered bays separately. The information collected during the two survey periods provided an overview of the farm drainage situation and potential waterlogging problems in the lasered and non-lasered paddocks.

Seventy four percent in 1998 compared to 58 % of farmer's during 1995 had lasered bays which did not pond irrigation water at the bottom of their bays. Similarly, 45 % in 1998 compared to 41 % in 1995 had non-lasered bays which did not pond irrigation water at the bottom of their bays (Table 3). Compared to 1995, a significant number of farmers in 1998 indicated that they had no ponding problem in lasered bays. Table 3 also shows that lasered bays are less likely to have water ponding compared to non-lasered bays in both the study periods.

Table 3. Water ponding according to bay types

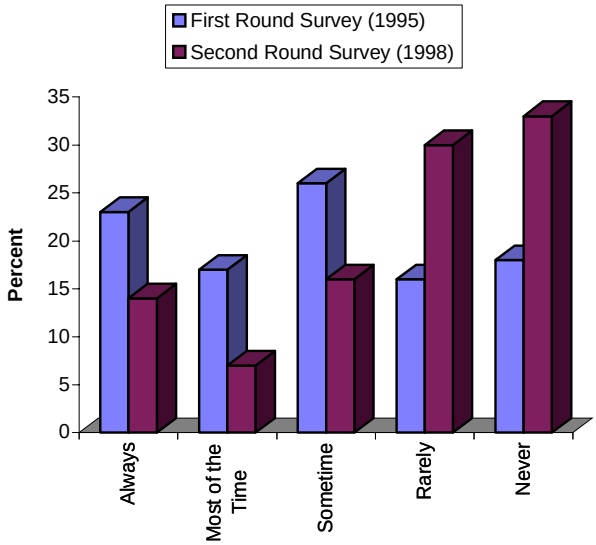
	% of Laser Bays		% of Non-Lasered Bays	
	First Round Survey	Second Round Survey	First Round Survey	Second Round Survey
No ponding at all	57.9	74.3	41.4	44.8
Ponding	42.1	25.7	58.7	55.2

3. Off-farm drainage

Farmers were asked "how often water ran off their farm during a normal irrigation". They were given five choices - always, most of the time, sometimes, rarely or never.

Figure 1 shows the responses about water leaving the farm in a normal irrigation. During 1995, 40 % of the farms indicated that water either always leaves the farm or does so most of the time. However, in 1998, only 21 % of the farms indicated the problem of water always, or most of the time leaves the farm. Conversely, the number of farms indicating that water rarely or never leaves the farm increased from 34% in the first survey to 63% in the second survey.

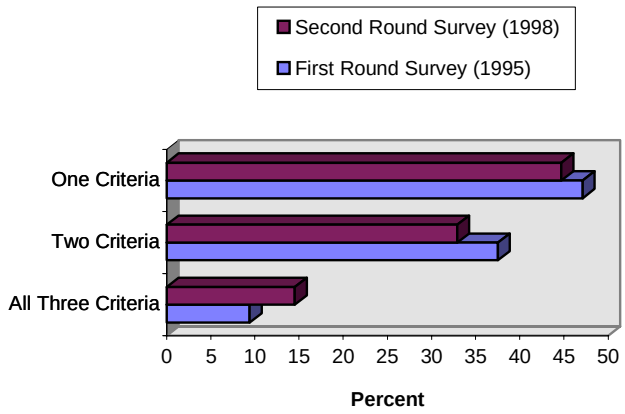
Figure 1: Irrigation Water Leaving the Farm



Number of farmers achieving best practice criteria

An assessment was made to see how many farmers actually satisfied these best irrigation management practices. Figure 2 shows the number of farmers satisfying 'best practice' criteria. The result shows that only 9 % of farmers achieve all three criteria in 1995 compared to 14.5 % in 1998. Figures for those farmers achieving two and one criteria appears similar during two study periods. The results in Figure 2 shows that there was a clear shift among farmers achieving all three criteria in 1998 compared to 1995.

Figure 2: Farmers Satisfying 'Best Practice' Criteria



Summary and conclusions

The first 'best practice' indicator focused on the issue of on-farm irrigation delivery structures capable of carrying the full flow of water through the meter outlets. Assessment of this indicator showed that more farms had more outlets with full flow of water in 1998 compared to 1995. However, the number of farms with full flow of water through all meter outlets during these two study periods appears to be similar.

Reduced flow through the meter outlet may arise from farm channels infested with weeds or from the inappropriate size of channels, stops or outlets. The flow may also be reduced by trying to water land which is at higher level than the supply channel. Sometimes, sufficient volume of water is not available from Goulburn-Murray Water (G-MW) channels and this will also affect the full flow of water through meter outlets. Also, G-MW channels have been run above full supply level in the past and some farm development has occurred based on the running level, rather than supply level. Improved awareness of the various reasons why some farmers are not able to get full flow of water through their outlets would appear valuable. This would include aspects such as farm channels infested with weeds, inappropriate structures or channels, or attempting to irrigate land which is at a higher level than the supply channel.

The second indicator for 'best practice' focused on the issue of ponding of water at the bottom of bays. The analysis highlighted the potential waterlogging problems in the lasered and non-lasered paddocks. Ponding of water not only reduces pasture performance, but also results in the increase of weeds affecting pasture quantity and quality. The study indicated that the problem was more severe in non-lasered bays compared to lasered bays in both the study periods. This could be mainly due to better drainage that often comes from improved layout when developing lasered bays, and not just because they are lasered. The figures for not ponding in lasered bays in 1998 was significantly better than during 1995.

The third indicator for 'best practice' focused on the issue of irrigation water leaving the farm. This would have consequences in relation to the volume and pollution of drainage water. About 40 % of the farmers reported that water either always leaves their farm or does so most of the time in 1995. There was a significant reduction in the number of farms reporting the same during 1998.

When farmers were assessed according to the above mentioned 'best practice' indicators, only 9 % of farmers achieved all three criteria in their farms in 1995 compared to 14 % in 1998. There was a clear shift in a positive direction at this level.

The 1997-98 irrigation season was dryer than average and water allocations of 130% of water right were below the usual expectation of 200%. Water right trading at prices 2 to 4 times initial cost was quite prevailent. This created an environment where water was a relatively scarce commodity and more highly valued. This situation was conducive to better water management and likely to have influenced the changes in best irrigation practice. It also highlighted the benefits of automated systems and clearly indicates the opportunity and a huge potential for irrigation extension staff to continue to work together with farmers to increase irrigation efficiency for better pasture production and a healthier environment.

Establishing a Process to Improve Irrigation Automation

Adoption Process of Automatic Irrigation

December 1997

Roger Standen and Greg Roberts
Department of Natural Resources and Environment
Institute of Sustainable Irrigated Agriculture, Cobram, Victoria

National Program for Irrigation Research and Development

Natural Resources and Environment
AGRICULTURE
RESOURCES
CONSERVATION
LAND MANAGEMENT

1. Introduction

The process leading towards the adoption of any technology, including irrigation automation is a complex one. Several factors of a social, economic, environmental and institutional nature contribute to the farm-level decisions affecting adoption (Guerin and Guerin, 1994; Rogers, 1995). Among these factors, attitudes of the individual towards the innovation can be a major factor in the adoption process. Accordingly, the purpose of this report is to explain the technology transfer and adoption process involved in the adoption of automated irrigation systems.

In this study, automatic irrigation has been identified as a vehicle to assess the processes involved in automation adoption. Automation for flood irrigation is the use of a device to operate irrigation structures so that one can change the flow of water from one bay, or set of bays, to another in the absence of the irrigator (Maskey, 1995). The Victorian Department of Natural Resources and Environment (DNRE) and Goulburn-Murray Water (G-MW) have encouraged automation on individual farms to improve irrigation productivity and efficiency. There are several reasons given for the attractiveness of adopting automation for flood irrigation. The primary reason was the saving of labour time for irrigating farms. With automation, there was less need to check regularly how far the water has travelled, or to regulate flows. This technology was supposed to improve the lifestyle of farmers and improve irrigation efficiency at farm level.

This report summarises the "program logic" model which was used to trace the processes involved in the adoption of automation. In the process, several types of analyses were also conducted to identify factors influencing the adoption of automation.

2. The approach

The project has used a "program logic" approach to develop, document and demonstrate a successful process of farmer adoption of technology. Before going any further, let us describe what is "program logic"? A "program logic" is a flow chart which is used to represent the cause-and-effect chains that are assumed to link program inputs to activities, and activities to outcomes. The "program logic" framework was developed by drawing a flowchart that described the logical steps that made up a program.

This project has used "program logic" model to identify the steps involved in the adoption of technology. The model provided the logical cause-and-effect links and served as a planning, implementation and evaluation tool. At the initiation of the project, the project team consisting of several members of a steering committee worked together to identify the hierarchical steps involved in the adoption of technology. The challenge was to identify the logic of how one step identified at a certain stage leads to another higher step(s) in the process of automation adoption. The complexity of the adoption process indicated that some of these stages are continuous rather than successive. At this point, the model served as a planning tool. As a planning tool, certain assumptions were made at each step. These assumptions were later tested during the implementation stage of the project. This was done by re-visiting the model several times during the course of the project to assess the actual situation and compare that with the original model. During the process,

several modifications were made to the original model by adding crucial steps which were not there before, and also identifying the complexity of linkages between the steps. The model also served as an evaluation tool. It helped in developing evaluation questions at each step. In particular, the model focused on evaluation questions on how well the program logic identified at planning stage worked in practice. Using the model, specific inputs and activities were identified, and it provided information as to whether they are working as intended. Evaluation questions that were posed were very specific and refer to specific points along the model. Some of the important evaluation questions were: What are the anticipated results for each step?; why do you think this will happen?; what else is happening?; and what are the causal links?

The "program logic" diagram identifying the process of automation adoption is presented in Figure 1. In the diagram, the steps are indicated by boxes. A step indicates a result which is a prerequisite for the occurrence of the next step. These steps were divided into two categories. The steps in parallelogram boxes indicate the activities and processes within the direct control of the project. The rectangle boxes indicate steps for which the project will have less influence over the adoption process. The boxes in italic indicate new steps included which were not there at the planning stage. The processes and outcomes involved in each of these steps is described below and is also presented as a summary in Appendix A. Following the description of processes and outcomes, detailed analyses were done to identify the factors influencing the adoption of automation.

The critical steps identified in the process to improve irrigation automation in the"Program logic" diagram were categorised into five stages which are presented in Figure 2. This process helped in grouping these steps into five stages of a project cycle to improve irrigation automation. The five stages were:

- Comprehension/preparation stage;
- Situation analysis stage;
- Program planning stage;
- Program implementation stage; and
- Monitoring and evaluation stage.

Fig 1: A Model Defining Critical Steps in a Process to Improve Irrigation Automation

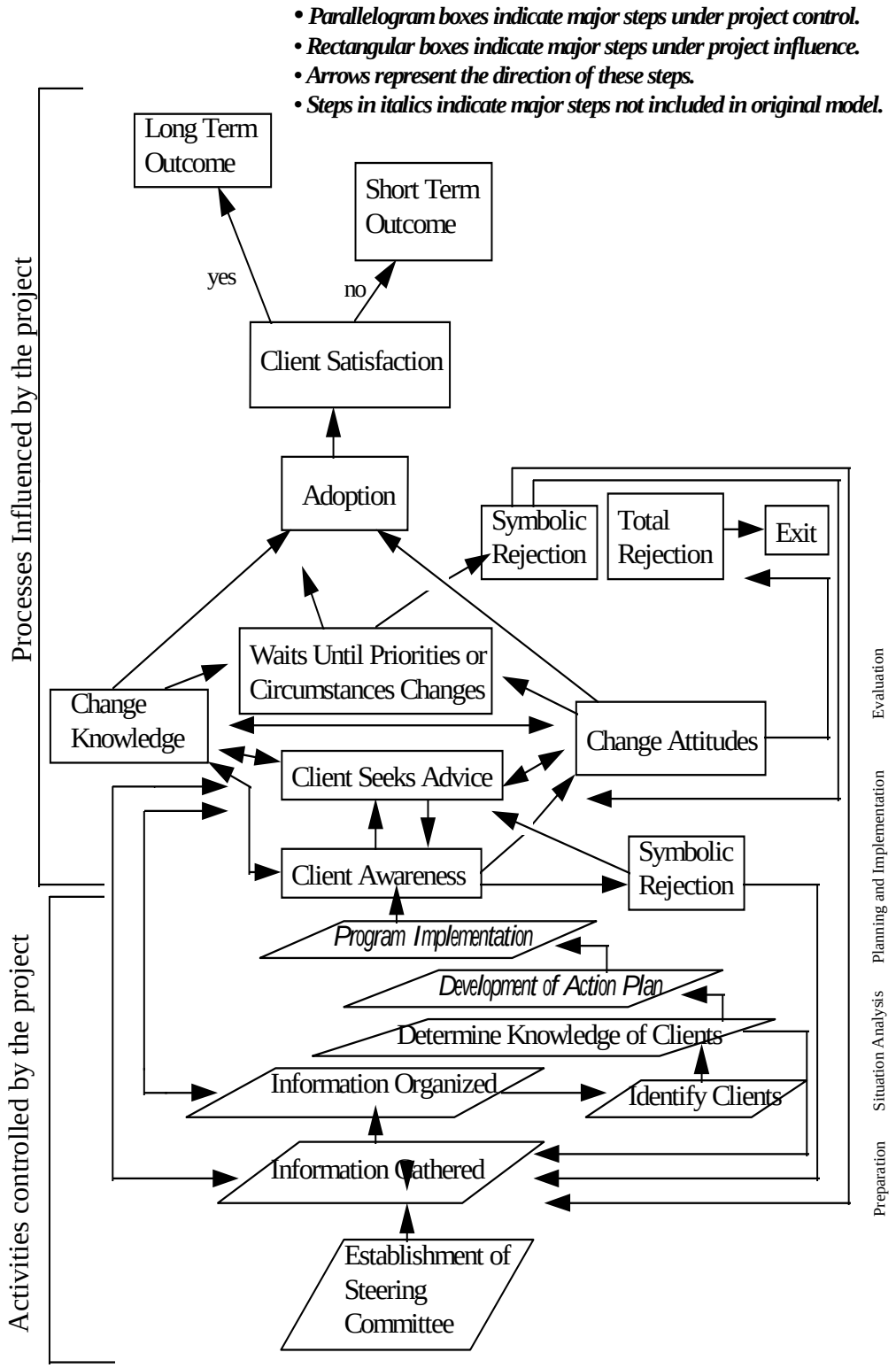
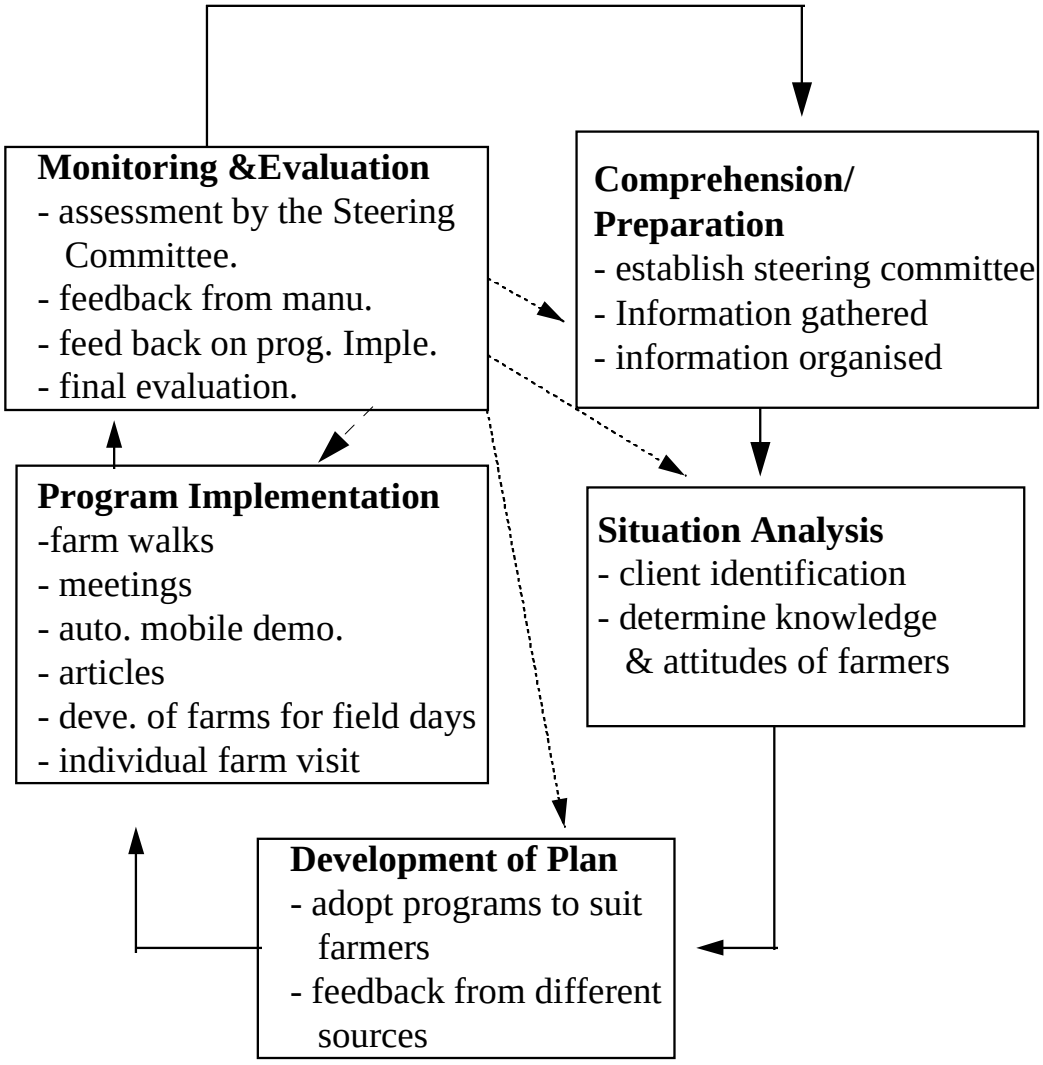


Fig 2:Project Cycle to Improve Irrigation Automation



3. Description of steps in the adoption process

The outcomes and processes involved in each of the steps in the "Program logic" model is described in this section. The overview of the outcomes and processes is also presented in Appendix A. The steps are grouped together as shown in Figure 2.

A. Comprehension/preparation stage

a. Comprehension/Preparation

A steering committee of stakeholders was established to enhance producer participation and ownership of processes to improve water management. The steering committee consisted of members of the DNRE (Department of Natural Resources and Environment), G-MW (Goulburn-Murray Water) and local irrigators. The involvement of local irrigators in the steering committee has helped in incorporating the local knowledge dealing with irrigation management throughout the process of project planning and implementation. From the initiation of the project, the steering committee members provided constructive and practical input to the effective implementation of the project. The involvement of local irrigators in the steering committee enriched the local knowledge dealing with irrigation management. Their continuous involvement, together with the inputs from the line agencies, enabled the committee to resolve a few basic parameters of best practice which they felt reflected what was achieved by the best irrigator in the Murray Valley. These parameters were later developed into four best irrigation practice benchmarks. These benchmarks were then used to measure the irrigation performance of irrigators in the project area (For details on the 4 BMPs, refer to Maskey, 1996). The steering committee, after developing the "program logic" model, re-visited the model several times to assess the impact of project activities on the adoption process.

b. Information Gathering

Appropriate information about what constituted good water management was gathered. Literature on different ways to control water and improve farm management efficiency, including information on automation was collected and were made readily available to those seeking the particular information. The list of publications and articles on automation is presented in Appendix B. In the process, the project officer also contacted various sources and prepared a report entitled "*Situation Statement on Automation for Flood Irrigation*" (Maskey, 1995). This report describes the historical development of automation in the region and highlights various agencies' support for automation. In addition, continuous effort was directed towards regularly updating knowledge on the subject. In the process, information from other relevant projects was documented. At present, DNRE has implemented a project entitled "*Identification of the major factors affecting water-use efficiency on irrigated dairy farms*". The major aim of the project is to benchmark and define "best management practice" for the use of water and land resources. This project focuses on identifying factors influencing water-use efficiency on irrigated dairy farms. The outcome of the project will enrich the pool of literature on water-use efficiency and will also provide clear guidelines for improved water management and enable rapid adoption of best practices.

Another project, "*Performance Testing of Automatic Irrigation Equipment for Flood Irrigation*", is being conducted at the Australian Irrigation Technology Centre (AITC) in Adelaide, to standardise the testing of the reliability of various systems. The information generated from this project will be helpful for the potential adoptor of automatic irrigation. In addition to DNRE and G-MW, Goulburn Valley TAFE also has a 20 hectare irrigation block where various automatic systems are demonstrated.

The systems are being used in the regular irrigation of the site and serves as a demonstration of various automation technologies and structures for local farmers.

c. Information Organisation

The information gathered was organised in a readily available form and made accessible to those who were seeking this information. It was also disseminated through newspaper articles, Target10 discussion groups, seminars, workshops and field day handouts.

B. Situation analysis

The step of situation analysis was vital for understanding the present knowledge and attitude of farmers about water management with a special focus on automation. It provided the base for planning the project for targeted implementation. This step consisted of two parts: identifying clients and determining farmers' attitude.

a. Identifying clients

The clients are initially Murray Valley irrigators with dairy farmers being the primary target.

b. Determine knowledge of farmer's attitude

A survey questionnaire was developed and implemented to determine the knowledge and attitude of farmers towards automation. The study provided data on the current knowledge and understanding of farmers and their attitudes to irrigation management, and farm development encompassing automatic irrigation, including barriers to adoption of new technology (for details, refer to Maskey, 1996[a] and Maskey, 1996[b]). Some of the important findings together with some possible guidelines for action are presented below;

- Only 8 percent of the farmers in the MVIA (Murray Valley Irrigation Area) had some form of automation.

- The study clearly showed that about 50 percent of the farmers had limited or no knowledge of automation. Information regarding irrigation management with a special focus on automation needs to be made available and accessible to farmers and discussion groups.

- To identify and assess the information sources, individuals were asked to identify the source of information through which they became aware of automation. "Field days" were the most common initial information source for the farmers of MVIA. Field days for automation should be one of the major techniques included in an action plan for encouraging automation adoption.

- The most important benefit identified by the farmers was the reduction of time and labour in irrigating pastures, resulting in an improvement in life style. They saw the full advantage of night watering without any disturbance to sleep.

- Cost of equipment was identified as a major barrier to adoption. Automation requires some form of capital investment. Considering that cost was a major

barrier, perhaps information on ways of reducing costs, or indications of relatively low expenditure required, will play a role in subsequent action plans. In this regard, access to taxation incentives and governmental and institutional loans could play a significant role in encouraging or constraining adoption.

- Only 6 % of the farmers had automation as their first priority for farm works, indicating that the process of adoption of automation is not a major agenda in farmers' lists of priority. Many farmers indicated that they had other farm priorities to deal with before installation of automation. Although automation was not the first priority of farmers in MVIA, the study clearly showed farmers' intension of moving in the direction of adopting automation.

The process contributed to development of action plans to achieve adoption of better water management.

C. Development of plan

The survey results were presented in various forums of professional groups, individuals and local dairy farmers. Inputs from local dairy discussion groups, local Murray Valley Water Service Committee (MVWSC), surveyors and designers, manufacturers of automatic equipment, extension and research groups helped shape programs for implementation. In the process of developing the plan, one of the important activities which did not come from survey findings and group feedback, but from the farmers themselves was the need for individual farm visits for those seeking specific advice on automation (described in detailed later). The activities identified by the project for each year and the justification for their implementation are attached in Appendix C.

D. Program implementation

The results from the survey and feedback from various groups contributed crucial information to the process of developing programs for better water management. Here, various extension techniques were used to disseminate specifically focused information about the advantages and disadvantages of adopting automation. Although some of the extension techniques used for the dissemination of information appear traditional, they were, however, specifically developed and implemented after careful consideration of survey findings and intensive consultation with other players in the industry. Some of the extension techniques used were:

a. Farm walks

During the life of the project, farm walks were organised on six properties where automation has been a part of the overall irrigation management. These walks introduced all types of automatic systems available in the market. Farmers interested in the system were able to ask about the advantages and disadvantages of automation with a farmer who had been running the system for sometime. This way, farmers had first hand information about the system and were able to identify how this could be implemented on their own farm. Immediately after farm walks, participants asked questions to the project officer and manufacturers on various systems to suit individual farm requirements. Thus, farm walks not only made farmers aware about the systems, but they also provided a catalytic impact in the

process of automation adoption. Farm walks were always evaluated, and farmers' comments were utilised to improve successive farm walks and field days.

b. Dairy discussion group meetings

There are five Target10 Dairy discussion groups in the Murray Valley Irrigation Area. These discussion groups were used as a forum to discuss efficient irrigation management practices. The best irrigation practice benchmarks developed by the steering committee were put forward to the group for their reaction. The advantages and disadvantages of automation for flood irrigation were also discussed. These groups also become the forum for demonstrating various automatic irrigation systems.

c. Mobile demonstration of automatic equipment

There are several automatic irrigation systems on the market. To help determine which system was best suited to a particular farm, a mobile demonstration of different types of automation was developed. This equipment was fitted on lightweight irrigation structures and could be packed into a trailer for transport. This working display offered a great opportunity for farmers to see the different types of automation at one site and decide which one might be the best for individual circumstances.

d. Newspaper and Journal articles

The irrigation management and lifestyle issues which were identified as very important to farmers were aligned with automation issues and continuously focused on in local newspapers. This improved farmer's awareness about present know-how on efficient irrigation management and how this related to their priority for an improved lifestyle.

e. Individual farm visits for those seeking specific advice

All the above stated activities were having some impact on farming communities and making them more aware about the available technology. Once aware of the innovation, individuals usually inquired about the detailed information necessary to identify and evaluate the advantages and disadvantages involved in adoption. They could do this by seeking more information and advice from different players in the industry.

For this, the project in its initial stages provided a personalised service by visiting individual farms. Some of the unique situations in individual farms were also discussed. This way, appropriate measures were taken to overcome the problems which are very much farm specific. In some instances, these individual farms were further visited by the project officer and local manufacturers of automatic equipment to discuss the best way of installing particular equipment in their individual farms. In most instances, these farms became a potential demonstration site for further farm walks.

In addition, there were several instances where the project officer acted as a catalyst in linking several players in the irrigation industry to irrigators who required specific

information about the advantages and disadvantages of different automatic equipment present in the market place. This way the irrigators had a chance to explore the opportunities and constraints about different systems and finally choose the system appropriate for their farm.

E. Client awareness

The awareness stage in the "program logic" diagram (Figure 1) indicates that nothing could move ahead if farmers are not in this stage. The whole process of adoption takes place only if potential adopters know about the innovation. As can be seen from the diagram, the impact from the project activities and information from other sources, will make farmers aware about the advantages and disadvantages of automation. The importance of awareness factor in the adoption process is analysed and discussed later in Section IV.

F. Client seeks advice

The logic diagram indicates that once aware of the innovative technology, farmers may require more information which is necessary to identify and evaluate the advantages and disadvantages of innovation. Thus, once farmers become aware about the advantages of automation, the potential adopter will then assess the benefits inherent in the innovation and compare that with the costs involved in adoption. For this, some farmers will seek information (as done by some farmers who asked for the farm specific advice) and for others information has to be provided through other means (communication with others and participation in project activities). The relationship between "Client Seeks Advice" and "Client Awareness" is very complex. As can be seen from the diagram, the steps are not just successive, but go in cyclic and continuum manner. The whole process from "Client Seeks Advice" can return to the information field and back again. This operation process can be infinitely repetitive.

G. Change knowledge and attitudes

Once farmers are aware about the advantages of automation, they will change their knowledge and attitudes about automation. This change in knowledge and attitudes are influenced by several factors. These factors are analysed and discussed in Section IV of this report. Knowledge about the innovation will help farmers to evaluate the benefits and costs of adopting the technology. For some, the benefits will far outweigh the costs and for others the reverse will be the case. If the perceived benefits of adoption substantially outweigh the costs, farmers could decide to adopt the technology. However, even at this stage, farmers could go into the "Waits Until Priorities or Circumstances Changes" phase. More knowledge about this phase will be obtained once the second survey is completed in March 1998.

H. Waits until priorities or circumstances change

The survey results (Maskey, 1996[a]) indicated that there is higher chance of farmers going into this phase before adoption. The survey findings showed that the adoption of automation is not a major agenda in farmers' list of priority. Many farmers had indicated that they had other farm priorities to deal with which came before installing automation. Laser grading was viewed as a major priority among farmers of MVIA. Other priorities were dairy improvement, debt servicing and

improved lifestyle. The major challenge is to link automation with some of these priorities. Many project activities were conducted specifically to promote the benefits of improved lifestyle from automation because this was seen to be the best chance of moving farmers into the adoption phase.

I. Adoption/rejection of technology

The adoption stage is more complex and could be influenced by several factors, the analysis of which is reported in Section IV. According to the "program logic" diagram, some will adopt the technology at this point, others will seek more information before they make a decision on adoption, and others may even reject the technology. Some might go through the process of symbolic rejection. It means that the adoption of technology is rejected at that point in time. Once individuals symbolically rejects the adoption process, they return to the information field or seek more information.

4. Analysis of factors influencing the adoption process

At this stage, three approaches were used to identify the factors influencing farmers adoption of technology. They were:

- Analysis of survey data to identify the processes involved in the adoption of technology.
- Feedback from farmers contacted during individual farm visit.
- Feedback from manufacturers.

A. Analysis of survey data

Detailed analysis of survey data is presented in three project reports (Maskey, 1996[a]; Maskey 1996[b] and Maskey 1997). Some important findings related to the adoption process are presented below.

The findings showed that there are significant differences in response to the perceived barriers and benefits about automation among different groups of farmers. The majority of farmers identified cost of automatic equipment as a major barrier. However, the analysis showed that a higher percentage of farmers who were not aware of automation identified cost of automation as a barrier compared to those farmers who were aware of automation. It showed that making farmers aware of automation helped them to overcome their perceived barriers about the cost of the equipment (Maskey, 1997- Table 1). In the process of adopting irrigation automation (refer to program logic figure), making farmers aware of automation was considered as an important step towards the adoption of automation. Another step towards changing the perception about the barriers and benefits of automation was to make farms identify automation as a priority in their farm operation. Identifying the characteristic of farmers with automation as a priority could help in this direction. A major analysis was conducted to explore farmers' attitudes towards the benefits and barriers of irrigation automation and the role played by such attitudes in farmers' priority to adopt automatic irrigation. The summary of the findings are given below;

- By far the most important barrier to installing automation was 'cost of equipment' closely followed by 'other priorities on the farm'.

- Among the benefits, the reduction in time and labour, a good nights sleep and the improved market value of the property were all scored highly by the farmers as benefits of automation, followed by flexible timing of water. Farmers also saw the benefits of automation in reduce water usuage, reduce runoff and better handling of bays and paddocks. Relatively few farmers seem to be convinced that automation could improve pasture quality and could increase stocking rate.

- Only 6 percent of the farmers indicated automation as their first priority. More than 14 percent indicated automation as their second priority and 26 percent as their third priority. Only 8 percent of farms already had some form of automation. Overall, these results suggest that automation is not considered a high priority amongst most farmers in the region.

The above results have implications for the success of on-farm irrigation automation and suggests that proper information be provided to farmers regarding the impact of automation. This may include;

- information on the real costs and benefits of automation.
- extension programs emphasising the importance of 'lifestyle' as a major benefit of automation.

Both these issues had an important impact on the level of automation adoption.

B. Assessment made by the steering committee

The steering committee of the project has assessed the process by reviewing the action taken in each of these stages. After assessing the action, feedback was provided as to how the project should follow to make it more effective. All the activities implemented through the project were approved by the steering committee. The steering committee also had close contact with the Murray Valley Water Service Committee (MVWSC). Information about the activities carried out through the project were regularly reported to the MVWSC. The steering committee and the MVWSC members continuously participated in assessing the newly developed centrally controlled hydraulic automatic system and showed interest in its use in the MVIA. These members often participated in activities like farm walks and provided feedback as to how these could be implemented more effectively in later stages of the project. The steering committee of the project identified that most automation technology applied to on-farm structures, and completely missed the opportunities provided by automation of the delivery wheel. Consequently, G-MW are addressing the issue of "wheel automation" by developing rules and regulations for its implementation.

C. Feedback from manufacturers

There are several manufacturers of automatic equipment operating in the project area. The list of automation irrigation manufacturers are provided in Appendix D. Most of them have provided their equipment for demonstration purposes. These manufacturers are providing continuous feedback as to how the approach taken up by the project could be improved. The increase or decrease in the number of

inquires and purchase of equipment after the implementation of the project is continuously assessed.

Precision Irrigation (Automation Irrigation Manufacturer), the only manufacturer located at the MVIA is happy with the number of inquiries and actual sale of automatic equipment. "The number of inquiries immediately after the farm walks are just amazing," John Padman, the manufacturer responded when asked about the interest of farmers about automation. In the last 18 months (May 1996 to October 1997), he reported that sales of automatic irrigation equipment had increased by more than 200 percent. When asked about sales within the MVIA, he confirmed that all his sales were not within the MVIA and also suggested that farm walks and other activities run though the project were achieving participation from farmers both within and outside the MVIA.

D. Feedback from farmers contacted during individual farm visit

The project officer provided farm visits to 23 farm properties from September 1996 to August 1997. Among them 9 farmers had already installed automation in their farm and were aiming to expand its use. Two had purchased the equipment and were in the process of installing, and the rest were in the process of installing the system. The need for capital investment and the appropriate time for installing automation were the reasons given for their delays. Most of the individual farms visited suggested the importance of farm specific information to adopt the technology. The farm specific services to individual farmers were considered crucial for automation adoption. "What is the best system for my farm and how is it going to work in my farm situation is crucial in the adoption process," reported a farmer, who had recently adopted automation. The need for a "complete package deal" on installing automation in farm specific situation is important criteria to automation adoption. This finding motivated the local manufacturer in the MVIA to provide farm specific service to those who were in the process of automation adoption.

E. Final evaluation

A survey similar to the one conducted at the beginning of the project will be implemented to assess the impact of the project. The success of the project will be assessed by:

i. identifying the number of farmers adopting automation.
ii. change in the awareness level on automation
iii. assess change in farmer's water management practice according to the best management practice criteria.

These survey results will further help identify the processes involved in the adoption of automatic irrigation.

5. Conclusions

The main advantage of using the "program logic" model in this project was its capacity to represent the cause-and-effect chains that are assumed to link program to activities, and activities to outcomes. It also helped in identifying the processes

involved at each step. Moreover, this single model acted as a planning, implementation and evaluation tool.

The "program logic" model used to identify the process of innovation adoption suggests that the process is complex. However, it gave a clearer view of the adoption process as a whole and recognised the need to go into details for each of the stages. The relationship between the stages suggested that the association is sometime cyclic and continuum, rather than just successive in one direction.

The qualitative and quantitative analyses to determine the factors influencing the adoption process suggest that the most important influence on the level of automation is costs and other farm priorities. Considering that cost was perceived as a major barrier, information provided through the project on ways of reducing costs, or indications of relatively low expenditure required could have played a significant role.

Many farmers had indicated that they had other farm priorities to deal with which came before installing automation. While improving lifestyle was placed as a high priority than automation, promotion done through the project about the strong benefits of improved lifestyle from automation could help the adoption of automation.

There are also farmers with a "wait and see" attitude because of a perceived lack of information. Access to information is probably the real issue here. Although they acknowledge the merit of automation, some farmers lack the self-confidence and motivation to adopt. There will be farmers who will observe the results of surrounding adopters before they decide to adopt. Moreover, many farmers are not sufficiently certain of the system's potential to make a substantial financial gain. The real challenge is to provide sufficient information to farmers through various extension activities. The extension activities implemented through this project made farmers aware of the advantages and disadvantages of automation and the improved lifestyle that it could bring to them.

The feedback from manufacturers of automation equipment and responses from individual farmers suggested that the process of automation adoption is moving in a positive direction. The challenge still remains for automation to be seen as an important priority at the farm level for reasons of efficient and sustainable water management. Nevertheless, increasing levels of adoption can still be achieved using "lifestyle" as the first point of interest.

References

Guerin, L.J. and Guerin, T.F., 1994, Constraints to the Adoption of Innovations in Agricultural Research and Environmental Management: A Review, *Australian Journal of Experimental Agriculture*, Vol. 34: 549-71.

Kulshrestha, S.N. and Brown, W.J., 1993, Role of Farmers' Attitudes in Adoption of Irrigation in Saskatchewan, *Irrigation and Drainage Systems*, Vol. 7, No. 2: 85-98.

Maskey, R., 1995, *Situation Statement on Automation for Flood Irrigation*, Cobram: DNRE.

Maskey, R., 1996 [a], *Attitudes of Dairy Farmers about the Automation of Flood Irrigation*, Cobram: DNRE.

Maskey, R., 1996 [b], *Irrigation Performance of Dairy Farmers in the Murray Valley Irrigation Area*, Cobram: DNRE.

Maskey, R., 1997, *Supplementary Analysis of Automated Irrigation Survey Data*, Cobram: DNRE.

Rogers, E.M., 1995, Diffusion of Innovations, New York:The Free Press.

Strachan, R., 1992, *Technology Trasfer - New Ways for New Times*, In: Smith, G.H.(ed) Effective Technology Transfer, Proceedings of an Industry Session at the Australian Society of Animal Production 19th Biennial Conference, Melbourne.

Tabachnick, B.G. and Fidell, L.S., 1996, *Using Multivariate Statistics*, 3rd edition, New York: Harper & Row.

Vizard, A. and Edwards, J., 1992, *Technology Transfer in the Wool Industry: Challenges and Opportunities*, In: Smith, G.H.(ed) Effective Technology Transfer, Proceedings of an Industry Session at the Australian Society of Animal Production 19th Biennial Conference, Melbourne.

Appendix A. Summary of outcomes and processes in "Program Logic" diagram

Establishment of Steering Committee	

Outcomes
Guidance from steering committee
	Processes
	• 4 BMPs to evaluate the irrigation performance.
	• re-visiting of "program logic" model.
	• inputs in:
	  • survey design.
	  • survey implementation.
	  • survey analysis.
	  • development of action plan.
	  • development of action plan
	  • program implementation.

Information Gathered	
Outcomes • List of publication, reference materials, booklets on automation • Identify other related projects	Processes • contact DNRE & GMW staff, surveyor & designers, manufacturers for information on Automation • Collection information about other related projects **ACTION** - Summarise the sources & historical background of Automation in a report entitled "*Situation Statement on Automation for Flood Irrigation*."
Information Organised	
Outcomes • All information & sources organised in a systematic manner	Processes • Organised information made available to those who are seeking this information. • Information was disseminated through newspaper articles, Target 10 discussion group meetings, seminars, workshops and field days or farmwalks.
Identify Clients	
Outcomes • MVIA is set as a boundary for program implementation	Processes • Identify different types of farmers in the MVIA. • Identify the number of dairy farmers in the MVIA. **ACTION**- Identification of survey sample to determine the knowledge of clients in higher step.

Determine Knowledge of Clients	
Outcomes • Survey results. Data analysed & report prepared to determine the knowledge & perception of farmers about automation.	Processes • questions on attitude of farmers about automation prepared. • questionnaire survey conducted.
Development of Action Plan	
Outcomes • Feedback from various players of the industry. • Development of action plan	Processes • Present information to various players of the industry.
Program Implementation	
Outcomes • Activities identified & implemented	Processes • farm walks. • dairy discussion groups. • mobile demonstration of automatic equipment. • newspaper and journal articles. • individual farm visits. lesson learned from the implementation documented & provided to most suitable players.
Client Awareness	
Outcomes • Documentation of awareness level.	Processes • Determine the awareness level of clients by: * Survey analysis * Talking to individual farmers * Feedback from manufacturers of automation • Identify different levels of awareness *Aware about automation * Aware about how some automation works * Aware about how some of the techniques might be used in own situation.
Client Seeks Advice	
Outcomes • Project officer providing farm specialist services.	Processes • Co-ordination between the project and manufacturers of automation help

• Manufacturers offering farm specialist services.	provide farm specialist information
Wait Until Circumstances Change	
Outcomes • Identified the cause of automation delay/symbolic rejection. • More Outcomes to convince farmers of the importance of automation	Processes • Provide farmers with other information (e.g. tax incentives, cost effectiveness of automation to encourage adoption of automation).
Change in Knowledge / Attitude	
Outcomes • Identify the characteristics of farmers for automation adoption Provide more farm specific information	Processes • Determine the change in knowledge and attitude of farmers and their readiness to adopt automation
Adoption	
Outcomes • Identify the trend of automation adoption. • Contact manufacturers to assess their sale of automation.	Processes • Determine the characteristics of farmers who adopt and who does not.
Symbolic Rejection	
Outcomes * no priorities * insufficient information * finance * logistic * socio-cultural variables	Processes • Determine the reason for rejection

Appendix B. Reports produced as an outcome of this project:

Maskey, R., 1995, *Situation Statement on Automation for Flood Irrigation*, Cobram: DNRE.

Maskey, R., 1996 [a], *Attitudes of Dairy Farmers about the Automation of Flood Irrigation*, Cobram: DNRE.

Maskey, R., 1996 [b], *Irrigation Performance of Dairy Farmers in the Murray Valley Irrigation Area*, Cobram: DNRE.

Maskey, R., 1997, *Supplementary Analysis of Automated Irrigation Survey Data*, Cobram: DNRE.

There are various articles and booklets which have been published during the past few decades, outlining the opportunities and advantages of automatic irrigation systems. Sources of some of these articles are listed below.

1. Cornish, J.B., 1967, Katunga Farmer Uses Pipelines for Pasture Irrigation, *Water Talk*, No.2: 4-5.

2. Trewhella, W.N., 1968, Farm Trial of Automatic Channel Checks, *Water Talk*, No.4: 8.

3. Murray Geoff (ed), 1969, Irrigation Automation, *Australian Country Magazine*, Vol. 26, No.2: 14-15 and 64.

4. Bedggood, R.E., 1975, What's New in Automatic Flood Irrigation, *Water Talk*, No. 34.

5. Salthouse, S., 1972, Automatic Irrigation at Katandra West, *Water Talk*, No. 20.

6. Fry, G. and Poulton, D., 1992, *Automatic Irrigation 1992*, Rural Water Corporation.

8. O'Connor, Rob, 1996, *Automatic Irrigation Census for Flood Irrigation in the Goulburn Murray Irrigation Region*, Echuca: DNRE.

9. Lawler, D., 1995, *Automation for Flood Irrigation*, Echuca: Agriculture Victoria.

The full descriptions of the present automatic systems are presented in the last publication listed above. This publication describe the types, concepts, methods and sources of automatic irrigation systems.

There are other manuals where the concepts, methods and design of automation for flood irrigation are discussed as part of a total package for improved farming. The two important sources are:

1. Mulcahy, S. and Schroen, J.(eds), 1993, *Target 10 Irrigation and Drainage Reference manual*, Agriculture Victoria.

2. Victorian College of Agriculture and Horticulture, 1989, *Land Layout for Flood Irrigation - A Whole Farm Approach*, Warragul: VCAH.

3. Rural Water Commission of Victoria, 1989, Farm Design for Border Check Irrigation, Vol. 1, Vol. 2 and Vol.3, Rural Water Commission of Victoria.

There are other booklets produced by different manufacturers for their own systems which they are promoting. The addresses of these manufacturers are given in the recent publication of David Lawler from Agriculture Victoria. Updated list of manufacturers of automation systems for flood irrigation is attached on Appendix 2.

In addition to the above mentioned publications, there is a video tape entitled "Automatic Irrigation Bus Tour" produced by G-MW demonstrating several types of automatic irrigation systems. A video produced by Victorian College of Agriculture and Horticulture shows demonstrations of automatic irrigation systems as a part of their package on whole farm planning.

Appendix D. Manufacturers of automation systems

Manufacturer	Contact	Telephone
Hydraulic Systems		
Farm Automation	Geoff Fry	0354 - 567314
O.B. Automatic Irrigation	Ian O'Brien	0354 - 567439
Miles Automatic Irrigation Systems	Neville Miles	0358 - 260367
Precision Irrigation	John Padman	0358 - 745282
Pneumatic Systems		
Precision Irrigation	John Padman	0358 - 745282
Mechanical Timers		
Precision Irrigation	John Padman	0358 - 745282
Electronic Systems		
Bay Watch	Rod McFadzean	0358 - 260447
Electronic Irrigation Systems	Richard Tallus	0358 - 286393
Farm - Mate Irrigation Control Unit	Ted Kaye	0354 - 365258
Rural Design	Brian Harwood	0358 - 523617
Irrigation Concepts (Automatic Irrigation Systems)	Andrew Laidlaw/ Keith Gates	0352 - 296617
Noel McDonald	Noel McDonald	0354 - 572238

Establishing a Process to Improve Irrigation Automation

Changes in the Attitudes of Dairy Farmers about the Automation of Flood Irrigation (1995-1998)

July 1998

Roger Standen and Greg Roberts
Department of Natural Resources and Environment
Institute of Sustainable Irrigated Agriculture, Cobram, Victoria

National Program for Irrigation Research and Development

Natural Resources and Environment
AGRICULTURE
RESOURCES
CONSERVATION
LAND MANAGEMENT

Introduction

Automation for flood irrigation has been identified as a vehicle to improve the lifestyle of farmers and improve irrigation efficiency at farm level. In this regard, a project entitled "Establishing a process to improve irrigation automation" has been implemented through the Department of Natural Resources and Environment (DNRE) and supported by LWRRDC (Land and Water Resources Research and Development), DRDC (Dairy Research and Development Corporation) and G-MW (Goulburn-Murray Water). In the initial stage of the project, a study was conducted to assess the knowledge and understanding of farmers, particularly their attitude to irrigation management and farm development with a focus on automatic irrigation. The study was carried out to achieve two objectives. Firstly, it was conducted to determine where farmers stood in different stages of the process of adopting better irrigation management in the hierarchical program logic model (refer to Maskey, 1996a, 1996b, 1997). This process has assisted in developing an action plan to achieve goals of adoption of better water management. Secondly, it was conducted to establish baseline information to determine the changes in practices that would occur over the life of the project. The main purpose of this report is to compare the findings of the present survey with the baseline information and identify changes that have occurred due to the implementation of this project.

Objective of the study

The overall objective of the study is to evaluate the changes in the attitudes and knowledge of dairy farmers about automation of flood irrigation as a result of implementing several automation related activities. These activities are listed in Appendix A. The details of these activities are presented in the report entitled "*Adoption Process of Automatic Irrigation*"(Maskey,1997). This report provides information on the differences between the baseline and present study on:

- farmers' awareness of automatic irrigation systems;
- sources of information on automation;
- farmers' perception of benefits of automation;
- their views on barriers to installing automation;
- priorities of dairy farmers and their likelihood of adopting automation; and
- characteristics of farmers with automation.

Study area

The study area is located in the Murray Valley Irrigation Area (MVIA) of Victoria which extends from Yarrawonga in the East to Barmah in the West and from the Broken Creek system in the South to the Murray River in the North.

Data and method

In the initial survey of May 1996, a random sample of 83 dairy farmers from the MVIA were interviewed. After this first round survey, the project went through the implementation phase, where several extension activities were carried out. During February 1998, a second round survey was conducted with 76 of the initial 83 farmers. Seven farmers did not participate in the second round survey - four of them had left their dairy farms and three indicated that they did not want to

participate in the survey. Among those seven who did not participate in the second survey, one had installed an automated system on their farm during the project period.

These 76 sampled farmers were contacted by telephone to arrange an appropriate time for the interview. The data was collected by face-to-face interview which recorded responses to a standardised questionnaire. The survey process was the same as that used in the first round survey.

Questionnaire design

Quesionnaires were administered to gain information about irrigation practices with a major focus on automatic irrigation. First and second round questionnaires were similar with the except that questions related to social aspects of practice change were added to the second questionnaire (Appendix B). The second round survey questionnaire was divided into four sections. The first section focused on general information about the dairy farm. The second inquired about water management practices. The third explored automatic irrigation systems and the fourth focused on social aspects.

Method of analysis

Mainly frequencies and percentages were used to describe the information derived from the primary data.

Results

Comparative results from the first and second round surveys about farmers' awareness, their perception, different information sources, present priorities in farming and their views on barriers to installing automation were described in the following sections.

Farmers' familiarity with automatic irrigation systems

Farmers were asked whether they were familiar with automatic irrigation systems. There was a clear positive shift especially from a group of having *limited knowledge* to a group with *some knowledge*. The shift among the *well informed* group was from 14.5 % in the first round survey to 18.4 % in the second round survey. The percent of farmers who indicated having no knowledge was almost the same for both the survey periods.

Table 1. Familiarity with automatic irrigation systems - A comparison between first and second round survey

Familiarity	First Round Survey (%)	Second Round Survey (%)
Well informed	14.5	18.4
Have some knowledge	37.3	50.0
Have limited knowledge	39.8	23.7
Have no knowledge	8.4	7.9

Individual farmers were asked to identify the source of information through which they became aware of automation. The information sources identified fell into five groups - government initiated, private initiated, jointly initiated, personal communication and mass media. Table 2 below indicates different sources of information for automatic irrigation systems.

Table 2 indicates that "field days" were the most common initial information source during both the survey periods. Between the two survey periods, there were significant shifts for the initial information source from DNRE extension staff (from 8.4 to 18.4 %), mass media (from 15.7 to 36.8 %) and neighbour and friends (from 15.7 to 27.6%).

Table 2. Information sources for automatic irrigation systems - a comparison between first and second round surveys

Information Field	Information Source	First Round Survey %	Second Round Survey %
Government Initiated Source	G-MW extension staff	2. 4	1.3
	DNRE extension staff	8. 4	18.4
	Discussion groups	3.6	2.6
	Farm walk	-	2.6
Private Initiated source	Manufacturers/dealers	15.7	22.4
Gov.and Private Initiated	Field days	57.8	63.2
Personal Communication			
	Neighbours/friends	15.7	27.6
	Other farmers having	7.2	-
Mass Media	automation		
	Mass media /publications	15.7	36.8

Respondents who indicated having no knowledge about automation did not respond.
The response to this question is of multiple choice nature, thus cumulative percent does not add up to 100.

Farmers were also asked where they would go to seek more information about automation. Most of the farmers in both periods indicated that they would either go to DNRE extension staff or manufacturers and dealers of automatic equipment. There were no significant changes between the two periods.

Table 3. Person/place to seek more information on automatic irrigation systems – a comparison between first and second round surveys

Information Field	Information Source	First Round Survey %	Second Round Survey %
Government Initiated Source	G-MW extension staff	18.1	6.6
	DNRE extension staff	31.3	32.9
Private Initiated source	Manufacturers/dealers	36.1	38.2
Gov. and Private Initiated	Field days	24.1	18.4
Personal Communication	Neighbours/friends	7.2	9.2
	Other farmers having automation	9.6	5.3

The response to this question is of multiple choice nature, thus cumulative percent does not add up to 100.

Table 2 and 3 indicates that the majority of farmers used field days as their main source of product and technology awareness and they liked to interact with government staff and private manufacturers for further information on automation.

Familiarity with different types of automation

Farmers were asked about the types of automatic systems that they were familiar with. There was a clear reduction among those farmers who said that they were not familiar at all with any of the automatic systems between the first (27.9 %) and second (11.8) round survey. The second survey also indicated a very large increase in farmers familiarity with hydraulic irrigation systems. Some of the farmers indicating their familiarity with hydraulic systems in the second round survey might be those who were reporting about the Precision Irrigation Hydraulic system, particularly as it was introduced during the period between surveys.

Table 4. Familiarity with different types of automation - a comparison between first and second round survey

System Type	First Round Survey %	Second Round Survey %
Not familiar at all	27.7	11.8
Pneumatic systems	54.2	56.6
Mechanical timers	38.6	42.1
Electronic systems	31.3	43.4
Hydraulic systems	3.6	40.8
Precision Hydraulic system	-	32.9
Electric fence	6.0	-
Talk back system	4.8	-
Water babies	1.2	-

The response was of multiple choice nature. Thus, cumulative percent does not add up to 100.

Adoption of automatic system

The first round survey showed that about 8 % of the farmers had channel structures or bay outlets that opened and closed automatically. The adoption of automation in the second round study had increased to 14 %, indicating a growth of 6 percent. There were several farmers who indicated having water baby alarm system on their farms. These farmers were not included as having automation.

Table 5. Use of automatic system at present - a comparison between first and second round surveys

Automatic System	First Round Survey %	Second Round Survey %
Presence of automatic system	8. 4	14.5
Absence of automatic system	91. 6	85.5

Benefits of automation

Farmers were asked to consider the benefits of automated irrigation systems on the scale of 1 to 5, 1 indicating no benefit and 5 indicating a lot of benefits. The pattern of response reported in both the surveys was almost the same. Among the benefits, the reduction in time and labour, a good nights sleep and the improved market value of property were scored highly by the farmers as benefits of automation, followed by flexible timing of watering. Improved lifestyle and the reduction in time and labour were clearly the most valued benefits of automated irrigation as perceived by the farmers in both the surveys. Flexible timing of water, flexibility in irrigating at night and weekends, and improved market value of property were other important factors recognised by the majority of farmers as a considerable benefit of automation. Relatively few farmers seem to be convinced that automation could improve pasture quality and could increase stocking rates.

Table 6. Response about the benefits of automation in percentage - a comparison between first and second round surveys

	Benefits of Automation	Don't know	No benefit 1	2	3	4	A lot of benefit 5
Life style/	Good night sleep						
Time	1996	7.2	-	6.0	12.0	15.7	59.0
factor	1998	2.6	6.6	3.9	11.8	19.7	55.3
	Reduce time and labour						
	1996	6.0	-	-	6.0	22.9	65.1
	1998	2.6	-	2.6	5.3	17.1	72.4
	Flexible timing of water						
Flexibility	1996	7.2	4.8	10.8	16.9	34.9	25.3
factor	1998	2.6	22.4	3.9	11.8	25.0	34.2

	Better handling of bays and paddocks	7.2	4.8	15.7	19.3	31.3	21.7
	1996	3.9	18.4	13.2	22.4	19.7	22.4
	1998						
	Flexibility in irrigating at night/weekends	7.2	2.4	10.8	12.0	31.3	36.1
	1996	3.9	14.5	7.9	11.8	26.3	35.5
	1998						
Productivity factors	Improve pasture quality	8.4	20.5	18.1	19.3	18.1	15.7
	1996	3.9	28.9	11.8	17.1	23.7	14.5
	1998						
	Increase stocking rate	9.6	26.5	25.3	18.1	15.7	4.8
	1996	3.9	46.1	13.2	19.7	7.9	9.2
	1998						
	Reduce water usage	7.2	7.2	9.6	24.1	32.5	19.3
	1996	2.6	17.1	15.8	13.2	15.8	35.5
	1998						
	Reduce runoff	7.2	10.8	10.8	18.1	27.7	25.3
	1996	2.6	15.8	15.8	18.4	14.5	32.9
	1998						
	Improve market value of property	6.0	2.4	6.0	7.2	41.0	37.3
	1996	2.6	6.6	10.5	17.1	32.9	30.3
	1998						

Farmers' choice for automatic irrigation systems

Farmers were also asked if they were to install automation, which system would they choose? In the first round survey, 59 percent of farmers said that they were not sure; however, in the second round survey, only 26 percent indicated that they were not sure. The reason given was that they did not have in-depth knowledge about the technology to choose among various options. In the second round survey, there were distinct group of farmers (6.6%) who indicated that they do not need automation in their farm and another (6.6%) did not respond to this question. Comparing between the two survey periods, there was a substantial increase in the number of farmers who would like to choose a pneumatic system and/or a hydraulic system. It is interesting to note a decrease in the number of farmers opting for mechanical systems.

Table 7. Farmers' choice for automatic irrigation systems - a comparison between first and second round surveys

Choice	First Round Survey %	Second Round Survey %
Not sure	59.0	26.3
No need		6.6
No response		6.6
Pneumatic system	13.3	23.6
Electronic system	8.4	9.2
Mechanical system	16.9	7.9
Hydraulic system	2.4	6.6
Padman's Hydraulic		13.2
Talk back system	1.2	

One respondent in the first round survey indicated that he might adopt pneumatic as well as mechanical timer.

Barriers to installing automation

Farmers were also asked to identify some of the barriers to installing automatic irrigation systems. They were asked to identify the barriers to adopting automation on the scale of 1 to 5, 1 indicating no barrier and 5 indicating large number of barriers. These barriers could be classified into four main categories. They are cost factor, maintenance and skill factors, requirements of accomplishing other farm activities (related to irrigation) before installing automation, and other priorities (not related to irrigation) on the farm. The major barriers identified by the farmers are shown below in Table 8.

Table 8. Barriers to installing automation - a comparison between first and second round surveys

Barriers to installing Automation		Don't know	No barriers 1	2	3	4	A lot of barriers 5
Cost	Cost of equipment						
	1996	7.2	4.8	3.6	9.6	31.3	43.4
	1998	-	2.6	3.9	21.1	18.4	53.9
Maintenanc	Lack of skills to handle						
e and skills	equipment	6.0	50.6	24.1	13.3	4.8	1.2
required	1996	-	76.3	11.8	5.3	5.3	1.3
	1998						
	Maintenance cost for the	13.3	26.5	37.3	14.5	8.4	-
	equipment	-	43.4	22.4	26.3	5.3	2.6
	1996						
Other farm	1998						
activities							
(related to	Need for re-layout of channels	4.8	21.7	13.3	15.7	24.1	20.5

irrigation) prior to installing automation	and bays 1996 1998	-	28.9	10.5	13.2	23.7	23.7
		4.8	44.6	18.1	2.4	18.1	12.0
	Need for detailed whole farm plan 1996 1998	1.3	48.7	14.5	6.6	11.8	17.1
		6.0	41.0	24.1	13.3	12.0	3.6
	Need for increased channel maintenance 1996 1998	-	47.4	21.1	13.2	7.9	10.5
		4.8	22.9	15.7	8.4	21.7	26.5
	Need for laser grading 1996 1998	-	34.2	7.9	11.8	18.4	27.6
Other priorities in farm (not related to irrigation)		4.8	2.4	6.0	16.9	33.7	36.1
		1.3	1.3	1.3	15.8	19.7	60.5
	Other priorities in farm 1996 1998						
Unreliability							
		30.1	18.1	22.9	19.3	6.0	3.6
		5.3	43.4	17.1	21.1	9.2	3.9
	Unreliability of the systems 1996 1998						

By far the two important barriers to installing automation were "cost of equipment" and "other priorities in the farm". In the second round survey, they were even more conclusive about these two factors which is shown by their shift from scale 4 from first round survey to scale 5 in the second round survey. Table 8 also identifies that the perceived pre-requisite activities related to adoption of automation, such as the need to re-layout channels and bays and accomplish laser grading, was of very low importance and continued to decline in importance as potential barriers.

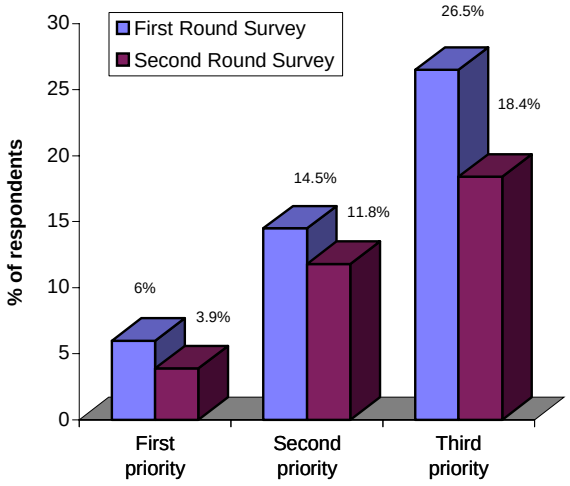
In both the surveys, the majority thought that unreliability was not a major hindrance for installing automation. However, in the first round survey there were 30 % who indicated that they did not know about the reliability factor of automation. This response shifted in the second round survey indicating that the majority considered that once they knew more about automation, unreliability was not a major barrier to installation.

Major priorities on farm

Farmers were asked about their three main priorities to spend additional money on, if their net farm income suddenly increased. Figure 1 provides information about where automation stands in terms of farmers' priorities in both first and second round surveys. There was a decrease in the priorities at all three levels in the second round survey compared to the first round survey. This can be a result of several issues. Firstly, there was a shift among farmers from these priority groups to

the actual adoption. Secondly, the second round survey was conducted at a point in time when farmers had to face low water allocations due to drought. This influenced some farmers to re-prioritise their options. Many were seeking to purchase more water rather than install automated systems.

Fig: 1 Priority for Automation



Tables 9, 10 and 11 provide the most common first, second and third priority during both the survey periods. In the first round survey, laser grading was viewed as a major first priority; however, in the second round survey, improving life style was considered to be the major first priority, followed by debt servicing followed by laser grading. Increasing the use of fertiliser and buying more water were also found to be an emerging priority in the second round survey. Automation was ranked fifth as a first priority, second as the second priority and first as the third priority in both the survey periods.

Table 9. First priority issues - a comparison between first and second round surveys

Priority	First Round Survey %	Second Round Survey %
Laser grading	19.3	14.5
Dairy Improvement	18.1	10.5
Debt service	9.6	15.8
Improve life style	8.4	18.4
Automation	6.0	3.9
Increase fertiliser	-	3.9
Buy more water	-	3.9

Table 10. Second priority issues - a comparison between first and second round surveys

Priority	First Round Survey %	Second Round Survey %
Laser grading	19.3	21.1
Automation	14.5	11.8
Improve life style	12.0	2.6
Dairy Improvement	9.6	6.6

Table 11. Third priority issues - a comparison between first and second round surveys

Priority	First Round Survey %	Second Round Survey %
Automation	26.5	18.4
Improve life style	15.7	5.3
Laser grading	9.6	1.3
Upgrade equipment	-	10.5
Improve irrigation structure	-	7.9

Characteristics of farmers with automation

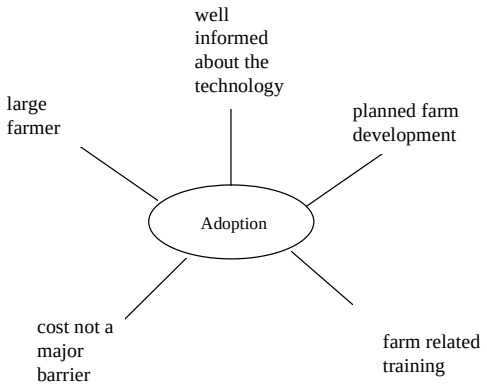
It is interesting to identify some of the characteristics of farmers who already had automatic systems in their farm and compare them with those who do not have automation. Among the many variables, five variables stood out distinctly. The first variable was the average area of permanent perennial pasture, usually indicative of farm size. Farmers with automation have significantly higher average area of perennial pasture (92 hectare) compared to those without automation (62 hectare). The majority of farmers with automation (82%) had a Whole Farm Plan (WFP) prepared compared to those not having automation (42%). More farmers with automation (91%) were found participating in farm related training programs compared to those without automation (61%). With regard to the awareness of various automatic irrigation systems, farmers with automation indicated that they were well informed about automation (46%) compared to those without automation (14%). The majority of farmers, irrespective of groups, identified cost of equipment as a major barrier. However, when these two groups were compared, the number of farmers who did not have automation reported that the cost of automatic equipment was a major barrier (76%) compared to those who had automation (45%).

Table 12. Distinct characteristics of farmers with automation and without automation

Characteristics	With Automation	Without Automation	Statistical test	Value of the test	Significance
Average area of perennial pasture (hectare)	92	62	t-test	1.92	0.05
Farm related training (% attending farm related training)	91%	61%	$\chi 2_{\text{test}}$	3.72	0.05
Preparation of WFP (% having WFP)	82%	61%	$\chi 2_{\text{test}}$	5.90	0.01
Well informed about automation (% well informed)	46%	14%	$\chi 2_{\text{test}}$	7.26	0.04
Cost as a barrier (% scoring cost as a barrier with a score of 4&5 in the scale of 1 to 5)	45%	76%	$\chi 2_{\text{test}}$	9.51	0.04

These five variables tell us a lot about the characteristics of farmers who had adopted automation. Farmers having a large permanent pasture area are more likely to install automated systems and the evidence indicates that most of them are using automation as a time saving technology. The other reason could be the better economies of scale of using automation in large farms. The majority of farmers with automation had a WFP done indicating that the planning of the farm facilitated the adoption of automation. The majority of those with automation had attended farm related training programs indicating their interest in gaining knowledge on better farm practices. The majority with automation were well informed about the automation technology and comparatively this group did not consider cost a major barrier compared to those groups without automation. The critical five variables are shown below.

Figure 2: Factors contributing to the adoption of automation



Summary of findings and their implications

In this section, certain important findings will be highlighted and some guidelines for action will be discussed.

- The rate of adoption of automation was increased by 6 percent during the life of the project; the period of intervention being about 18 months.

- There was a large shift in the awareness level of farmers about automation. The shift was more significant from having limited knowledge to having some knowledge.

- "Field days" were the most common initial information source on automation for farmers during both the survey periods. However, between the two survey periods, there were significant increases in the use of DNRE extension staff and mass media as initial information sources.

- During both the survey periods, dairy farmers identified two major types of benefits from automation. The most important one was the reduction of time and labour in irrigating pastures resulting in an improvement in lifestyle. The flexibility in farm work was the other important factor recognised by the farmers as a benefit of automation. In both the survey periods, relatively few farmers were aware of the improvement in pasture productivity factors.

- When farmers were asked about their choice for different types of automatic systems, in the first round survey, 59 percent said that they had no idea compared to 26 percent in the second round survey.

- During both the survey periods, cost of equipment was identified as a major barrier to adoption. During both periods, many farmers indicated they had "other farm priorities" to deal with which came before installing automation. This was also clearly reflected when farmers were asked about their three main priorities to spend their additional money on, if their net farm income suddenly increased. For most of them, automation was not their first priority.

- During the second round survey, there was a decrease in the priorities of automation at all three levels compared to the first round survey. However, their priority ranks for automation were not changed during the two survey period.

- The analysis showed that the farmers with automation had characteristics of being large farmers, with most of them having WFPs, who were involved in farm related training, who do not consider cost as a major barrier and were well informed about the technology.

Recommendations

- Farmers were clear that they would go to DNRE staff to get more information about automation. This clearly showed that extension staff were recognised as being in the position to provide up-to-date information on automation at all stages towards adoption.

- Cost of equipment was identified as a major barrier to adoption. Information on ways of reducing costs, or indications of relatively low expenditure required to be presented to farmers. The cost effectiveness of this technology needs to be discussed with farmers.

- In the second round survey, farmers indicated that improved life style was their first priority. Automation technology has been, and can continue to be, marketed to include life style issues for dairy farmers.

- The characteristics of farmers with automation showed that their adoption was popular among large farmers. As discussed before, large farmers might be using automation as a time saving technology. Moreover, the economies of scale in using automation among large farmers were better than among small farmers. A study focusing on the costs and the benefits of using automation in different situations might help in understanding their use.

- Detailed farm planning using WFP's was found to be popular among those adopting automation. It would be advisable to consider automation during the preparation of a WFP.

- Farmers were found to be at different stages in their level of awareness and adoption of automation. For the effective and efficient implementation of an extension program, farmers could be divided into different groups in terms of their perception and their level of farm situation. This could help focus an extension program according to the client situation.

- Special incentives for farmers using automation could help increase the adoption rate. With automation, farmers have more flexibility to irrigate according to their

need. Farmers could get incentives for irrigating at night. This way, they could take full advantage of night watering without any disturbance to sleep.

- Many farmers indicated that they had other farm activities with a higher priority which came before installing automation. Their priorities for laser grading was found to be significant. It would be advisable to consider planning for automation during laser grading so that the irrigation system could be easily automated in the future.

- There were many farmers who were not sure which system might best suit their properties. A mechanism to provide information to individual farmers about the systems which might best suit their particular situation would impact positively on adoption rates.

References

Maskey, 1996a, *Attitudes of Dairy Farmers about the Automation of Flood Irrigation*, Cobram: DNRE.

Maskey, 1996b, *Irrigation Performance of Dairy Farmers in the Murray Valley Irrigation Area*, Cobram: DNRE.

Maskey, 1997, *Adoption Process of Automatic Irrigation*, Cobram: DNRE.

Appendix A

I. Extension Activities

- farm walks
- dairy discussion group meetings
- mobile demonstration of automatic equipment
- newspaper and journal articles focused on farmer perceived benefits
- individual farm visit for those seeking implementation advice specific to the farm

II. Interaction and consultation with manufacturers of automation.

III. Interaction and consultation with other DNRE extension and research staff and G-MW staff.

IV. Interaction with Murray Valley Water Service Committee

Appendix B

We are conducting a survey to find out the views of irrigators on managing water on farms with a special focus on automatic irrigation systems. The questionnaire is divided into three sections. The first section seeks general information about the dairy farm. The second inquires about water management practices and the third explores details on automatic irrigation systems. Individual questionnaires are kept confidential. Details gained from the survey will be made available as aggregated information.

General Information

a. No.:

b. Location:

c. Years in dairy farming: _____

d. Total number of milking cows at present:_____

e. Area Under Permanent (summer) Pasture:_____
f. Area under Annual (sub-clover) Pasture:_____

g. How many people work regularly on the farm? _____

h. What is your water right?

_____ML

i. How much water did you use last year? (estimate)

REMEMBER TO INCLUDE TEMPORARY TRANSFER OF WATER UNDER OTHERS

1. Water Right _____ML
2. Sales Water _____ML
3. Others (please specify) _____ML

j. Do you have other species in your pastures besides ryegrass and white clover?

Yes_____ No_____

k. Please specify the other species in your permanent pasture?

1.
2.
3.
4.

Water Management

THE INFORMATION ASKED BELOW THIS SECTION IS IN RELATION TO PERMANENT PASTURE.

PLEASE PROVIDE THE INFORMATION IN THE TABULAR FORM.

1. How many meter wheels do you use to irrigate your permanent pasture?
2. What is the average revolutions per minute for each of the meter wheels?
3. Provide the area irrigated from each of the meter wheels.
4. Provide the irrigation duration (in hours) for each of the meter wheels.
5. Can you please describe the main soil types in your permanent pasture?
(e.g., light (fine sandy loam); medium (shallow loam); heavy (clay soils))
6. How much of your permanent pasture is laser graded?(in percent)
7. If you have a re-use system, is it used to water served by this wheel?
8a. If not, provide the area of other wheels it irrigates.
8b. If not to any of the wheels, provide the new area it irrigates.
9a. If you have a groundwater/or drainage diversion pump, which wheel area do you pump to?
9b. If not to any of the wheels, provide new area it irrigates.
9c. How many ML/irrigation do you pump?

Types of Wheel	Q.1 Number	Q.2 Revs. per min.	Q.3 Area Irrigated	Q.4 Irrigation Duration (hrs)	Q.5 Soil Type	Q.6 Percent Lasered	Q.7 Re-use water to irrigate its own wheel area	Q.8a Area of other wheels it irrigates	Q.8b Area outside wheel area	Q.9a Wheel area covered by ground water pump	Q9b New area covered by ground water pump	Q.9c ML/irrigation from ground water
Small Meter Outlet												

Large Meter Outlet												
Speed Wheel												

10. How often do you irrigate your permanent pasture in January?

11. Ideally, how often do you think you need to irrigate to obtain good quality pasture in January?

IF THE RESPONSES TO Q. 10 AND Q.11 ARE DIFFERENT, PLEASE ASK THE FOLLOWING QUESTION.

12. What stops you from following your ideal irrigation schedule?

13. How do you decide when to irrigate?

14. What is the length of the largest and the smallest bays in your permanent pasture?

	lasered	**nonlasered**
largest	_____ length	_____ length
smallest	_____ length	_____ length

15. What do you think is the optimum bay length for irrigation to obtain good quality pasture?

_____

16. What affects the time taken to irrigate a bay or group of bays?

17. What is your reaction about the time required to irrigate your bays at present (on average)? You consider this as:

a. Too long
b. Too short
c. About right

18. Why do you consider this too long/too short/about right?

_____
_____
_____
_____
_____
_____

19. What do you think is the ideal duration for irrigating your largest bay?

_____hours for lasered bay

_____hours for nonlasered bay

20. How do you decide when to cut off water to each bay?

21. If you decide to cut off water by using distance, how far on average down the bay do you allow?

_____ % for laser graded bays _____% for nonlaser graded bays

22a. For how long does water pond at the bottom of your bay?

_____ for lasered bays _____ for nonlasered bays

22b. Does this apply to your whole farm?

Yes_____GOTO 23 No_____ GOTO 22c

22c. What proportion of your farm?

_____

23. Do you have a drainage re-use system?

Yes _____ GO TO 24 No _____ GO TO 26

24. How much (in percent) of your permanent pasture is served by a drainage reuse system?

_____ %

25. What is the storage capacity of your reuse system?

_____

26. How often does water runoff the farm during a normal irrigation?

a. always
b. most of the time
c. sometimes
d. rarely
e. never

(QUES. 27 BELOW IS ABOUT GROUND WATER QUALITY)

27. Have you tested the ground water quality in last 12 months?

Yes_____ No_____

Q. 28a, Q. 28b,Q. 28c and Q. 28d IS ABOUT DAIRY SHED EFFLUENT.

28a. How many hectares of your farm do you apply dairy effluent?

_____ha

28b. Does this area where effluent is applied, drain to a re-use system?

Yes_____GOTO 28c No_____ GOTO 28d Not applicable_____

28c. Is this re-use system then used to water the same area it drains to?

Yes_____ GOTO 29 No_____ GOTO 28d

28d. What happens to the drainage water from where the effluent was applied?

_____

_____

_____

29. Are you satisfied with the flow rate that you get from the wheel(s)?

Yes _____ No _____

30. What do you think are the major restrictions to the flow from the wheel?

PLEASE SCALE THEM FROM LEAST IMPORTANT TO MOST IMPORTANT (i.e.,1=LEAST IMPORTANT FACTOR FOR RESTRICTION, 5= MOST IMPORTANT FACTOR)

Major Restrictions to the Flow from the Wheel	1 LEAST IMPORTANT	2	3	4	5 MOST IMPORTANT
a. Presence of weeds in farm channels	1	2	3	4	5
b. Slope of channel	1	2	3	4	5
c. Size of channel	1	2	3	4	5
d. Type or size of channel structures	1	2	3	4	5
e. Type or size of bay outlets	1	2	3	4	5
e. Flow available from G-MW	1	2	3	4	5
f. High ground	1	2	3	4	5
g. Other _____	1	2	3	4	5
	1	2	3	4	5

31. On the scale of 1 to 5, what is your level of satisfaction with the present system of irrigation in your farm?

1	**2**	**3**	**4**	**5**
Not satisfied				**very satisfied**

32. What aspects of your present irrigation system are you happy with?

_____
_____
_____
_____
_____
_____
_____
_____

33a. What aspects of your present irrigation system are you unhappy with?

_____
_____
_____
_____
_____
_____
_____
_____

33b. What are the reasons why you have not fixed any of these?

_____
_____
_____
_____
_____
_____
_____
_____

34. Do you recognise any area of your farm as wetland for flora and fauna conservation which could still provide drainage and/or water for irrigation?

Yes_____ No_____ Don't know_____

Automation:

THIS SECTION SEEKS YOUR IMPRESSION OF AUTOMATIC IRRIGATION SYSTEMS.

35. How well informed are you about automatic irrigation systems?

a. well informed
b. have some knowledge
c. have limited knowledge
d. have no knowledge GO TO 37

36. What were your sources of information for automatic irrigation systems?

37. Where would you go to seek more information?

38. What types of automatic systems are you familiar with?

a.
b.
c.
d.

39. Do you have any channel structures or bay outlets that open and close automatically?

Yes_____ No_____

40. On the scale of 1 to 5, which of these things do you consider to be benefits of an automated irrigation system?

PLEASE SCALE THEM FROM NO BENEFIT TO A LOT OF BENEFIT IF YOU WERE TO ADOPT AUTOMATION. (i.e. 1 = NO BENEFIT, 5 = A LOT OF BENEFIT)

READ EACH ITEM CAREFULLY. IF SOME BENEFITS ARE NOT INCLUDED, PLEASE LIST THEM IN THE SPACE PROVIDED.

PLEASE CIRCLE THE RESPONSE

Benefits of Automation	1 NO BENEFIT	2	3	4	5 A LOT OF BENEFIT
a. Improve pasture quality	1	2	3	4	5
b. Increase stocking rate	1	2	3	4	5
c. Reduce time/labour on watering	1	2	3	4	5
d. Reduce runoff	1	2	3	4	5
e. Improve market value of property	1	2	3	4	5
f. Reduce water usage	1	2	3	4	5

g. Getting a good night sleep	1	2	3	4	5
h. Flexible timing of watering	1	2	3	4	5
i. Better handling of bays and paddocks	1	2	3	4	5
j. Flexibility in irrigating at	1	2	3	4	5
night/weekends	1	2	3	4	5
k.	1	2	3	4	5
l.					

41. If you were to install a new automatic irrigation system, which system(s) would you use? why?

_____
_____
_____
_____
_____
_____
_____
_____

42. On a scale of 1 to 5, please indicate which of the following you see as a barrier to installing automatic irrigation systems?

PLEASE SCALE THEM FROM NO BARRIER TO LARGE BARRIER.
(i.e. 1 = NO BARRIER, 5 = LARGE BARRIER)

READ EACH ITEM CAREFULLY. IF YOUR REASON IS NOT INCLUDED PLEASE STATE IT IN THE SPACE PROVIDED.

PLEASE CIRCLE THE RESPONSE

Barriers to Installing Automation	1	2	3	4	5
	NO BARRIER				LARGE BARRIER
a. Cost of equipment	1	2	3	4	5
b. Lack of skills to handle the equipment	1	2	3	4	5
c. Maintenance cost for the equipment	1	2	3	4	5
d. Other priorities in the farm before installing automatic equipment	1	2	3	4	5
e. Need for Re-layout of channels and bays	1	2	3	4	5
f. Need for detailed whole farm planning	1	2	3	4	5
g. Unreliability of the automatic systems	1	2	3	4	5
h. Need for increased channel maintenance	1	2	3	4	5
i. Need for laser grading	1	2	3	4	5
j. Others (specify)	1	2	3	4	5

43. If your net farm income suddenly increased, what would be your three main priorities to spend the additional money on.

PLEASE PROVIDE YOUR PRIORITIES IN ORDER.

1._____
____

2._____
____

3._____
____

Supplementary Analysis of Automated Irrigation Survey Data

Association between perceived benefits and barriers, and different groups of farmers

The perceived barriers and benefits of automation identified by farmers were an important basis for developing an extension program for automation adoption. However, these perceptions can be different among different groups of farmers. The analyses were performed to identify differences about these perceived barriers and benefits among different groups of farmers. The differences were looked at by dividing the farmers into the following categories:

- farmers who were aware of automation compared to those who were not;
- farmers who regarded automation installation as one of the first three priorities in the farm compared to those who considered it a less important priority; and
- those who already had automation and considered it as their first priority compared to the rest who did not consider it as the first priority.

Association between awareness of automation and perceived barriers and enefits

Farmers were asked whether they were familiar with automatic irrigation systems. Farmers who were well informed and had some knowledge of automation were grouped as one category and farmers who had limited knowledge or had no knowledge at all were grouped as another category. Table 1 summarises the relationship between awareness about automation versus barriers to installing automation. Out of all the perceived barriers, two variables, namely, cost of equipment ($p<0.10$) and need for the whole farm plan (WFP) ($p< 0.05$) were significantly different between these two groups.

Table 1. Association between awareness of automation and perceived barriers

Perceived Barriers	Aware %		Not Aware%		Statistical Test		
	no barriers	lots of barriers	no barriers	lots of barriers	χ^2 value	D.F.	Sig.
Cost of equipment	*26.2*	*73.8*	*11.4*	*88.6*	2.65	1	0.10*
Lack of skill	*93.0*	*7.0*	*94.3*	*5.7*	0.05	1	0.82
Maintenance cost	*95.1*	*4.9*	*83.9*	*16.1*	2.55	1	0.11
Other priorities	*32.6*	*67.4*	*19.4*	*80.6*	1.73	1	0.19
Need for re-layout of the system	*60.5*	*39.5*	*44.4*	*55.6*	2.02	1	0.15
Need for the Whole Farm Plan	*79.1*	*20.9*	*55.6*	*44.4*	5.01	1	
Unreliability	*89.2*	*10.8*	*81.0*	*19.0*	0.76	1	0.02**
Need for increased channel	*83.7*	*16.3*	*82.9*	*17.1*	0.01	1	0.38
maintenance	*55.8*	*44.2*	*41.7*	*58.3*	1.57	1	0.91
Need for laser grading							0.21

Figures in italic indicate percentages.

* significant at 0.10 level. ** significant at 0.05 level.

The analysis shows that higher percentage of farmers who were not aware of automation identified cost as a barrier compared to those farmers who were aware of automation. The differences were significant at 0.10 level. Similarly, the higher percentage of farmers who were not aware of automation recognised the need for WFP as a barrier. There were no significant differences between these groups for other barriers.

These two groups were also compared to identify how they perceived the benefits of automation. Table 2 shows that there were significant differences between the awareness level and three benefits identified by farmers. The higher percentage of farmers who were aware of automation perceived that automation could improve pasture quality compared to those farmers who were not aware about automation. Interestingly, higher percentages of farmers who were not aware of automation recognised that with automation they would be able to handle bays and paddocks better. Also, higher number of this group perceived that the market value of the property would increase with automation.

Table 2. Association between awareness of automation and perceived benefits

Benefits	Aware %		Not Aware%		Statistical Test		
	no benefits	lots of benefits	no benefits	lots of benefits	χ^2 value	D.F.	Sig.
Improve pasture quality	*52.4*	*47.6*	*76.5*	*23.5*	4.69	1	0.03**
Increase stocking rate	*75.6*	*24.4*	*79.4*	*20.6*	0.15	1	0.69
Reduce time and labour	*7.1*	*92.9*	*5.6*	*94.4*	0.08	1	0.90
Reduce runoff	*47.6*	*52.4*	*37.1*	*62.9*	0.86	1	0.35
Improve market value	*26.2*	*73.8*	*5.6*	*94.1*	5.94	1	0.01**
Reduce water usage	*52.4*	*47.6*	*34.3*	*65.7*	2.54	1	0.11
Getting a good night sleep	*21.4*	*78.6*	*17.1*	*82.9*	0.22	1	0.63
Flexible timing of watering	*31.0*	*69.0*	*40.0*	*60.0*	0.69	1	0.41
Better handling of bays and paddocks	*53.7*	*46.3*	*30.6*	*69.4*	4.18	1	0.04**
Flexibility in irrigating at night	*26.2*	*73.8*	*28.6*	*71.4*	0.05	1	0.82

Figures in italic indicate percentages.

** significant at 0.05 level.

Association between perceived barriers and benefits, and farmers indicating automation as a priority

Farmers were asked about their three main priorities in farm development. Farmers who identified automation as one of the three main priorities were identified as one group and the rest were regarded as another group. Five barriers were identified to be significantly different between these two groups (Table 3). These variables are; cost of equipment ($p<0.10$), maintenance cost ($p<0.05$); need for re-layout of the irrigation system ($p<0.01$); need for increased channel maintenance ($p<0.05$) and need for laser grading ($p<0.01$).

Table 3. Association between automation as a priority and perceived barriers

Perceived Barriers	Automation as a Priority %		Automation not as a Priority %		Statistical Test		
	no barriers	lots of barriers	no barriers	lots of barriers	χ^2 value	D.F.	Sig.
Cost of equipment	*27.0*	*73.0*	*12.5*	*87.5*	2.58	1	0.10*
Lack of skill	*89.2*	*10.8*	*97.6*	*2.4*	2.27	1	0.13
Maintenance cost	*97.1*	*2.9*	*83.8*	*16.2*	3.66	1	0.05**
Other priorities	*31.6*	*68.4*	*22.0*	*78.0*	0.94	1	0.33
Need for re-layout of the system	*71.1*	*28.9*	*36.6*	*63.4*	9.41	1	
Need for the Whole Farm Plan	*71.1*	*28.9*	*65.9*	*34.1*	0.25	1	0.002***
Unreliability	*90.0*	*10.0*	*82.1*	*17.9*	0.75	1	0.61
Need for increased channel	*92.1*	*7.9*	*75.0*	*25.0*	4.11	1	0.38
maintenance	*65.8*	*34.2*	*34.1*	*65.9*	7.90	1	0.04**
Need for laser grading							0.004***

Figures in italic indicate percentages.

* significant at 0.10 level.
** significant at 0.05 level.
*** significant at 0.01 level.

The majority of farmers, irrespective of groups, identified cost of equipment as a major barrier. However, when these two groups were compared, the number of farmers who did not consider automation a priority thought that cost of automatic equipment was a major barrier compared to those who consider automation as a priority. Interestingly, a higher percentage of farmers who had no preference for automation thought that there would be an additional need to re-layout their irrigation system before adopting automation. This group also perceived that there would be a need for increased channel maintenance and a need for laser grading for the adoption of automation.

There were no significant differences between these groups on benefit variables, except for one variable about the reduction of water usage with automation (Table 4). Higher percentages of farmers who did not consider automation as priority believed that automation would reduce water usage.

Table 4. Association between automation as a priority and perceived benefits

Benefits	Automation as Priority %		Automation not as a Priority %		Statistical Test		
	no benefits	lots of benefits	no benefits	lots of benefits	χ^2 value	D.F.	Sig.
Improve pasture quality	*60.5*	*39.5*	*65.8*	*34.2*	0.23	1	0.63
Increase stocking rate	*70.3*	*29.7*	*84.2*	*15.8*	2.08	1	0.14
Reduce time and labour	*5.3*	*94.7*	*7.5*	*92.5*	0.16	1	0.68
Reduce runoff	*51.4*	*48.6*	*35.0*	*65.0*	2.09	1	0.14
Improve market value	*21.1*	*78.9*	*12.5*	*87.5*	1.03	1	0.31
Reduce water usage	*57.9*	*42.1*	*30.8*	*69.2*	5.74	1	
Getting a good night sleep	*23.7*	*76.3*	*15.4*	*84.6*	0.85	1	0.02**
Flexible timing of watering	*26.3*	*73.7*	*43.6*	*56.4*	2.52	1	0.35
Better handling of bays and	*40.5*	*59.5*	*45.0*	*55.0*	0.16	1	0.11
paddocks	*21.1*	*78.9*	*33.3*	*66.7*	1.46	1	0.69
Flexibility in irrigating at night							0.22

Figures in italic indicate percentages.

** significant at 0.05 level.

Association between adopter and potential adopter of automation, and perceived barriers

In the previous section, farmers were categorised according to their priority for automation. In this section, farmers who already had an automatic system (seven farmers) and those who consider automation as a first priority (five farmers) were grouped as one category (referred to here as the first group). The remaining farmers were classed as the second group. The analyses were carried out to observe the association between these groups of farmers and the perceived benefits and barriers(Tables 5 and 6).

Table 5. Association between farmers with automation and automation as first priority and perceived barriers

Perceived Barriers	Immediate Automation %		Not Immediate Automation %		Statistical Test		
	no barriers	lots of barriers	no barriers	lots of barriers	χ^2 value	D.F.	Sig.
Cost of equipment	*44.4*	*56.6*	*16.2*	*83.8*	4.05	1	
Lack of skill	*77.8*	*22.2*	*95.7*	*4.3*	4.24	1	0.04**
Maintenance cost	*100*	-	*88.9*	*11.1*	1.11	1	
Other priorities	*44.4*	*55.6*	*24.3*	*75.7*	1.66	1	0.04**
Need for re-layout of the system	*66.7*	*33.3*	*51.4*	*48.6*	0.74	1	ns
Need for the Whole Farm Plan	*66.7*	*33.3*	*68.6*	*31.4*	0.01	1	0.19
Unreliability	*88.9*	*11.1*	*85.7*	*14.3*		1	0.38
Need for increased channel	*77.8*	*22.2*	*84.1*	*15.9*	0.23	1	0.90
maintenance	*55.6*	*44.4*	*48.6*	*51.4*		1	ns
Need for laser grading							0.63 ns

Figures in italic indicate percentages.
** significant at 0.05 level.

Table 6. Association between farmers with automation and automation as first priority and perceived benefits

Benefits	Immediate Automation %		Not Immediate Automation %		Statistical Test		
	no benefits	lots of benefits	no benefits	lots of benefits	χ^2 value	D.F.	Sig.
Improve pasture quality	*44.4*	*55.6*	*65.7*	*34.3*	1.54	1	0.21
Increase stocking rate	*77.8*	*22.2*	*77.3*	*22.7*	0.00	1	0.97
Reduce time and labour	-	*100*	*7.2*	*92.8*	0.69	1	0.40
Reduce runoff	*33.3*	*66.7*	*44.1*	*55.9*	0.38	1	0.53
Improve market value	*11.1*	*88.7*	*17.4*	*82.6*	0.22	1	0.63
Reduce water usage	*44.4*	*55.6*	*44.1*	*55.9*	0.00	1	0.98
Getting a good night sleep	-	*100*	*22.1*	*77.9*	2.47	1	0.11
Flexible timing of watering	-	*100*	*39.7*	*60.3*		1	
Better handling of bays and	*25.0*	*75.0*	*44.9*	*55.1*	1.16	1	0.28
paddocks	-	*100*	*30.9*	*69.1*	3.82	1	0.05**
Flexibility in irrigating at night							

Figures in italic indicate percentages.

** significant at 0.05 level.

There was a significant difference between these groups regarding the cost of automatic equipment (Table 5). There were significantly less farmers in the first group who considered cost of equipment as a major barrier compared to those in the second group ($p<0.05$). Similarly, in terms of benefits, all farmers in the first category recognised that automation would bring about the flexibility in irrigating at night compared to the second group where only 69 percent of farmers recognised that automation will bring about flexibility in irrigation (Table 6).

Characteristic of farmers with automation as a priority

In the process of adopting irrigation automation (refer to program logic chart), making farmers aware of automation was considered important. It was considered as a first step towards the adoption of automation. Also from the analysis it showed that making farmers aware of automation helped them to overcome their perceived barrier about the cost of the equipment (Table 1). Moreover, it showed that the farmers who were aware of automation noticed the important benefit of automation to improve pasture quality (Table 2). The analysis further showed that those farmers who were aware of automation had a better chance of making automation priority (Table 8). Thus, making farmers aware of automation was in itself a positive step towards adopting irrigation automation.

Another step towards changing the perception about the barriers and benefits of automation was to make farmers identify automation as a priority in their farm operation. Tables 7 to 9 show that there were significant differences between these two groups in terms of their perceptions and farm characteristics. Table 7 shows that those farmers who had automation as a priority were using more permanent pasture compared to those who did not have automation as a priority ($p<0.01$). Also, a higher percentage in the first group with automation as a priority were more aware of automation ($p<0.01$) (Table 8). Moreover, most of these farmers in the first group were from the East and Central part of the MVIA ($p<0.05$) (Table 9). This is 'upstream' in the main irrigation water delivery system where supply water levels during irrigation is often perceived to be more consistent.

Table 7: Average area under permanent pasture for farmers with different priority about automation

Group	Mean (ha)	Standard Deviation
Automation as priority	74.54	48.75
Automation not as the first three priority	52.41	24.78

t-value = 2.65 DF = 81 Sig = 0.01

Table 8. Association between automation as a priority and awareness about automation

		Aware About Automation	
	No.	Aware	Not Aware
Automation as priority	39	61.5	38.5
Automation not a priority	44	43.2	56.8

χ^2 value = 2.79 DF = 1 Sig = 0.094

Table 9. Association between automation as a priority and location

	No.	Location	
		East and Centre	West
Automation as priority	39	71.8	28.2
Automation not a priority	44	50.0	50.0

χ^2 value = 4.10 DF = 1 Sig = 0.043

At this stage, it is necessary to understand the characteristics of farmers who had a priority for automation. Variables which identified the differences between these groups were analysed. Tables 7 to 9 and Table 3 show that the groups were different in terms of the following variables:

- average area under permanent pasture;
- awareness of automation;
- location of their farms; and
- those who perceive cost of equipment as a major barrier.

A model was developed to find out how these variables behave to distinguish between farmers who had a priority for automation compared to those who had not. It was assumed that farmers' priority for automation is dependent upon the variables mentioned above.

Since the dependent variable "priority for automation" was made to a dichotomous variable, the logit model was used for the analysis, instead of normal linear regression. The relationships of dependent variables with the independent variables are presented in Table 10.

Table 10. Definition of variables

Variables		
Dependent Variable	Priority for automation	automation not as a priority =0 automation as a priority = 1
Independent Variables	Location	west part of MVIA = 0 east and centre part of MVIA = 1
	Awareness about automation	not aware about automation = 0 aware about automation =1
	Cost of automatic equipment as a barrier	cost of equipment as a major barrier = 0 cost not as a major barrier = 1

The result of the analysis is presented in Table 11. It suggests that all these variables were important for determining farmers' priority for automation. The variable 'location' is significant at 0.01 level while the variable 'types of farmers' is significant at 0.05 level and the variable 'awareness' is significant at 0.10 level. The variable 'cost of the equipment' has a significant level at 0.11 level.

Table 11. Summary of the analysis

Variables	Co-efficient	Standard Error	Degree of Freedom	Significance
Types of farmers	0.0065	0.0034	1	0.05
Aware about	0.9052	0.5393	1	0.09
automation	1.3314	0.5555	1	0.01
Location	1.0764	0.6921	1	0.11
Cost of equipment	-5.8954	1.7318	1	0.00
Constant				

The analysis shows that the farmers with automation as a priority had a characteristic of being large farmers, who were aware of automation and were located in the East and Centre part of MVIA and who did not consider the cost of automatic equipment as a major barrier.

Some Social Aspects of Dairy Farmers in the Murray Valley Irrigation Area

Background

The final survey conducted as part of the project "Establishing a Process to Improve Irrigation Automation" included a section to help encapsulate the basic demographic data representing the population of dairy farmers in the Murray Valley Irrigation Area of Northern Victoria.

It was hoped that this would build understanding of the target audience and possibly identify opportunities to further develop extension activities.

The tabulated data follows the summarised comments.

Summary

1. Long term planning for farm development when characterised by either a willingness to pass the farm on to family members, an intention to be a dairy farmer in future years, or the farmers perception of the future of the dairy industry, indicated a range from 20 to 40% of the sample with positive views. This could provide market segmentation for the promotion of investment in automation where the costs are distributed over a longer period.

2. Involvement of family members on or off the farm provided a measure at that particular point in time. However, it is likely that trends in this type of data would be far more useful in identifying possible opportunities for technology transfer programs.

3. Membership of community groups in the survey sample highlighted a very high participation rate in local Sporting Clubs (59.5%). Data collected by Target 10 (dairy extension program) in the Northern Victorian Irrigation Region (P Shannon - pers comm) agreed with the figure of about 30% membership of Target 10 discussion groups as measured by mailing lists, but active participation in groups approximated 10 to 15%. As a very large number of farmers may not be readily accessible via Target 10 groups, local sporting clubs appear a likely and potentially rewarding vehicle for first level contact.

R. Maskey
G. Roberts
June 1998
DNRE, ISIA COBRAM

Table 1. Pass on the farm to family members

Pass on the farm to family members	Percent
Yes	39.5
No	51.3
Don't Know	9.2

Table 2. Intention of being a dairy farm

Intention of being a dairy farm	Percent
Next 5 years or less	23.7
Next 6 -10 years	21.1
Next 11-15 years	9.2
Indefinitely	28.9
Don't know	17.1

Table 3. Future of dairy industry

	very good future						no future at all
	1	2	3	4	5	6	7
Percent of farmers	11.8	11.8	30.3	27.6	7.9	2.6	7.9

Table 4. Family members involved in the present frm

Involvement	Percent
Yes	73.7
No	26.3

Table 5.Family members involved in other dairy farm

Involvement	Percent
Yes	20.0
No	80.0

Table 6. Family members involved in other activities contributing to the present dairy farm

Involvement	Percent
Yes	22.4
No	77.6

Table 7. Involvement of family members on off-farm employment

Involvement	Percent
One family members involved	17.1
Two family members involved	2.6
Three family members involved	1.3

Table. 8 Member of vrious community groups

Community Groups	Percent
Local service group	25.1
Sporting Club	59.5
Church group	23.7
Landcare group	37.6
Water service committee	3.2
T10 Group	31.3

Many participants indicated their involvement in more than one group.

Table 9. Level of education of the participants

Level of Education	Percent
Primary	1.3
Some Secondary	52.6
Completed Secondary	26.3
Certificate	11.8
Degree or Diploma	7.9

Table 10. Age group of the participants

Age Group	Percent
25 - 30	3.9
31 - 35	9.2
36 - 40	15.8
41 - 45	17.1
46 - 50	21.1
51 - 55	13.2
56 - 60	10.5
Above 60	9.2