

National Program for Irrigation R&D:

Technology Transfer and Adoption in Irrigation

Occasional Paper No 03/94

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Technology Transfer and Adoption in Irrigation

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Sponsors

Land & Water Resources R&D Corporation
Rural Water Corporation of Victoria
NSW Department of Water Resources
Queensland Department of Primary Industries
Irrigators

January 1994

Published by:

The Land and Water Resources Research and Development Corporation

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Land and Water Resources Research and Development Corporation

GPO Box 2182

Canberra ACT 2601

Phone: (06) 257 3379

Fax: (06) 257 3420

Publication data:

Cape, J., Chamala, S. and Syme, G. (1994). National Program for Irrigation R&D: Technology Transfer and Adoption in Irrigation. LWRRDC Occasional Paper Series No 03/94.

ISSN 1320-0992

ISBN 0 642 20586 8

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1. Introduction

In September 1993 the Management Committee of the National Program for Irrigation R&D requested the authors to prepare a briefing paper on Technology Transfer. The Committee had identified technology transfer and adoption as a key issue for the R&D program to address.

The Committee required a position paper "which concisely summarises the current situation and proposes a strategy that the program might adopt to significantly advance progress in technology transfer and adoption".

Eight issues were defined in the brief:

1. Who is identifying the needs of irrigators?
2. What do irrigators want in terms of technology, planning and management materials?
3. How do irrigators use information from irrigation R&D programs?
4. What decisions are irrigators making about technology and irrigation management R&D?
5. Why are irrigators not benefiting from advances in irrigation technology?
6. What are the barriers to irrigation technology uptake?
7. What is the existing technology which is not being adopted but should?
8. Is there likely to be greater returns to the encouragement of adoption of technology for particular target groups, and how should target groups be segmented - by performance criteria (eg efficiency of water use, income), or by irrigator type (type of output, size etc).

Would better targeting be affected by giving attention to technology types and categorisation of such (eg simple, complex, low costs, generic, industry specific)".

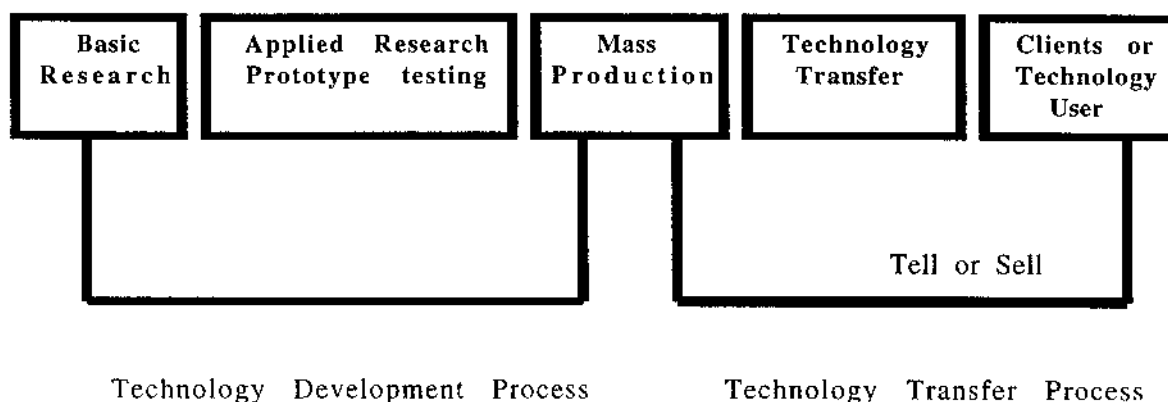
In addressing these issues the consultants prepared a preliminary paper which outlined a particular philosophy with regard to technology transfer.

The Management Committee agreed with this fundamental approach and this position paper was prepared with that philosophy as the foundation.

2. The Current Situation

Technology Transfer as a topic has been receiving a great deal of attention across a wide range of industries and disciplines. There is widespread recognition that technical progress depends on a close relationship between the generation of new techniques and the adoption of those new techniques by the industry as a whole. What has also been recognised is that traditional ways of segregating industries do not reflect the actual behavioural and decision making processes which occur when irrigators adopt new technologies. This approach is summarised in Figure 1. Industry extension schemes designed according to traditional models have resulted in a significant technological gap between what is available and what is used commonly.

Fig 1 Traditional R&D and Technology Transfer Model - A Linear Model



The irrigation industry has identified a technology gap and the Management Committee of the National Program for Irrigation R&D is keen to find ways of shrinking it. An important first step in this process is to recognise the deficiencies of the traditional technology transfer model.

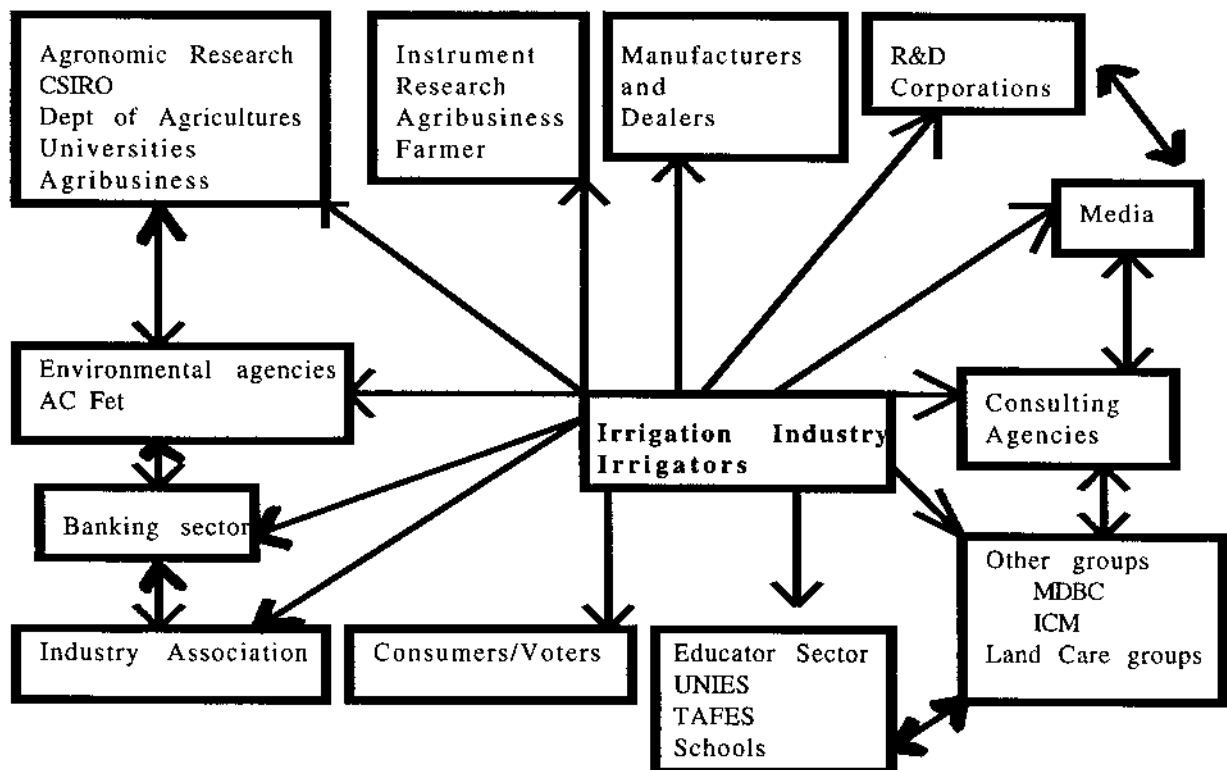
Most industries now appreciate the need for a system related approach which includes farmer and industry input from problem definition through technology development to use. There is an understanding that it is not possible to make a clear distinction between technology development and technology transfer sectors. The following principles are gaining wide acceptance by all stakeholders.

- "Technology transfer projects" are about improving technical performance, for example, yield per megalitre of water applied. The focus should always be on achieving the goals, the tools required to get there are secondary to achieving the goal; if the goal is achieved it doesn't matter what technology is used!
- The problems must be defined and recognised as problems by irrigators before they will act on any new technology. The adoption of soil moisture monitoring equipment is a technology that has the potential to reduce water consumption significantly. However an irrigator is unlikely to investigate soil moisture monitoring unless a problem due to excessive water use is obvious to the irrigator. In other words irrigators will only act when the benefits of acting are very clear.
- The adoption of new technology on a farm is likely to represent a change in the management of the whole farming system. Promoters of technologies different from those currently in use sometimes fail to realise that adoption of the new technology impacts not just the target of the new technology but the rest of the farm management practices as well. Thus adoption is likely to involve a range of other questions in addition to those originally raised by the technology per se.
- New technologies and management practices will not be used unless both the potential beneficiaries and the promoters of the new techniques have the necessary skills. This may require significant training and on-farm management investigation for all parties involved in the process before satisfactory outcomes are achieved.
- "Technology Transfer" is an act of adoption by an irrigator, not a process of absorption of techniques developed by research centres. Studies have shown that irrigators place a high degree of importance on seeing techniques demonstrated in "live" situations. There is a strongly held belief that research station techniques need to be modified before they are of any use in the "real world".
- The importance of target audience involvement. Analysis of technology transfer programs across a range of industries has clearly demonstrated the need to have target audiences intimately involved in the process if successful and permanent results are to be achieved. This view of "involvement" requires more regular and problem orientated interaction than is provided by the traditional periodic review of individual projects by Advisory bodies. In this context it means irrigators setting the agenda with the technical assistance of experts who provide resources to guide decision making on an ongoing basis.
- The use of new technology requires an ability and a desire to cope with and manage change. As described adoption of new technology is part of a complex process, requiring not only mastery of the new technique but an understanding of the broader implications of the change. Any changes will impact not only the irrigator but the people and organisations with whom the irrigator interacts. The attitude of the group is an important factor in determining the individual's attitude to risk and change.

These points are strong evidence in support of the view that the industry is best represented as a dynamic system. Figure 2 summarises this systems perspective. It follows from this view that the widespread adoption of new technology depends to a great extent on the views and perceptions of irrigators. Any projects to improve the rate of adoption should be developed against this background.

Figure 2

Stakeholders in Total Systems Perspective of R&D Model for Irrigation Industries



Participative Action Management

A useful model that describes a methodology suitable for this situation is the Participative Action Management Model (PAM). PAM is characterised by:

- a shared vision and management
- participative problem/opportunity identification
- participative planning for research and development
- participative implementation and monitoring

- development of participative structures by establishing industry groups and joint project teams/projects at various levels within the total industry perspective
- development of personal/group capacities through training, support, allocation of responsibilities, and opportunities for learning by doing.

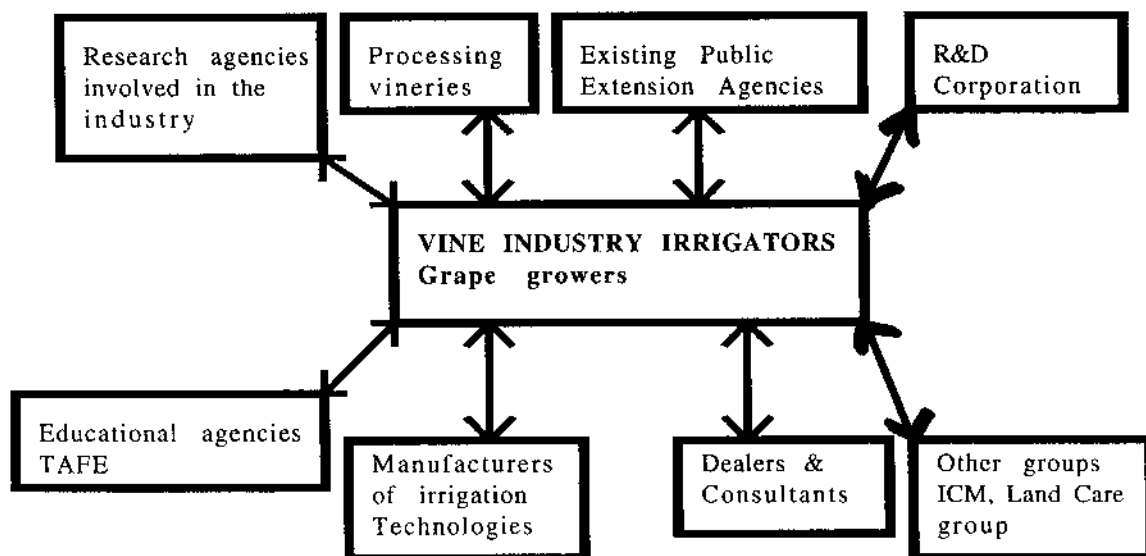
Figure 3 summarises a systems overview of the irrigated grapevine industry and the groups who would be involved in an industry focussed technology transfer project for this industry.

Figure 3

**Innovative Irrigation Technology Transfer (Action Research)
Projects Based on PAM Model**

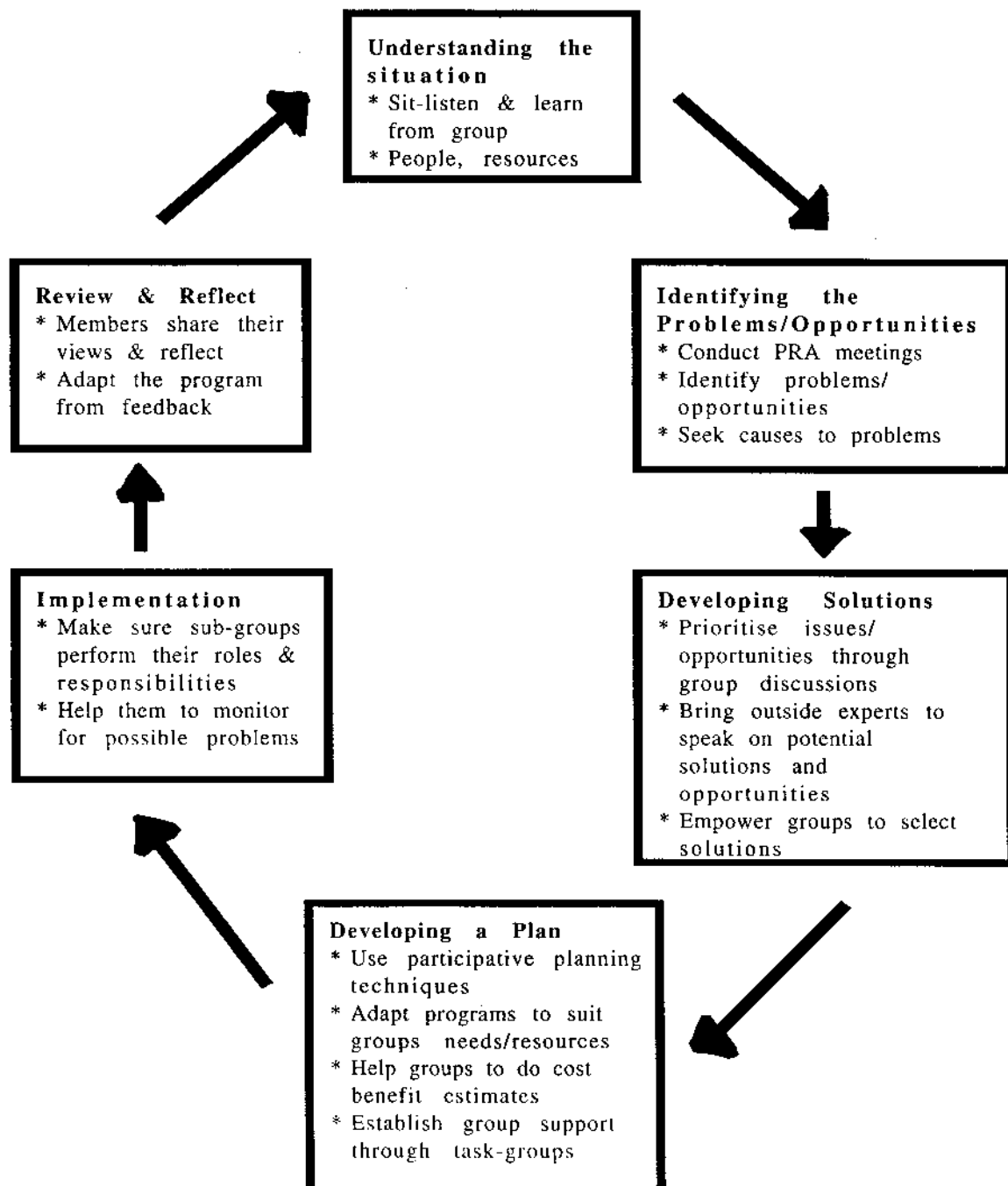
INDUSTRY FOCUSED PROJECT

The stakeholders form project teams, they identify issues/opportunities, develop common goals, define roles, responsibilities, implement action projects and monitor and fine tune the project process.



The PAM process begins with developing a clear understanding of the industry or project specific situation. From this point common problems or opportunities are identified and action plans developed to deal with them. The PAM planning cycle is summarised in Figure 4.

Figure 4
PAM Planning Cycle



The PAM approach is used by many LANDCARE groups. The key differences between this approach and "traditional" discussion groups is the wider range of stakeholders involved and the emphasis on developing strategic actions to address particular problems. The actions are implemented, reviewed and modified if necessary. The problem solving cycle described in Figure 4 becomes an important learning process for participants. This learning process is critical to the success of such projects.

3. The Next Steps

3.1 General

The technology transfer program aims to show irrigators that there are techniques, equipment and technology they can use which will make them better off. The PAM process is proposed as a way to help irrigators understand this and to encourage them to act on their opportunities.

It is appreciated that involving irrigators and other industry players in projects can be difficult, however industry participation in the spread of technology is essential if it is to be successful. In marketing terms it could be said that the program committee is faced with a sceptical audience but for any programs to be successful two key aspects must be clearly highlighted: the central role of the irrigator and the benefits for them of a successful outcome. The scepticism of the audience makes the work harder but not impossible.

It is important in such conditions to generate some positive momentum. A small initial success can be the positive feedback required to have the group move on to tackle larger problems. Most people will not change unless the pain of change is perceived to be less than the pain of staying the same. If this is true then potential targets for technology transfer programs can be identified, for example irrigators facing a significant increase in charges or decrease in water allocation will be more likely to look at changing their management. Identifying irrigators faced with these types of challenges will help to overcome the barrier of workshop inertia, particularly if possible solutions to the challenges are communicated.

The National Management Committee is not the only organisation faced with the problem of improving the flow of technology throughout the irrigation industry. A range of other groups are dealing with the same issues. Other R&D corporations, water supply authorities, food processing plant operators, and conservation groups all have an interest in seeing more widespread adoption of technology which will lead to better water use efficiency and greater productivity. Appendix 1 is a description of a successful project that had industry wide support. A "champion" is often needed to bring such groups together, the committee should consider whether it wants to play such a role or whether it wants to throw its support behind an existing technology transfer project currently funded by another Corporation. Involvement could be contingent on the project adopting the PAM model. This could be an easier step than trying to persuade other groups to join a National Management Committee project.

In summary the following conclusions can be drawn:

- Technology transfer programs need to adopt an irrigators view of the world, or a client perspective.
- Groups should be identified who are faced with making technical changes as a result of some other change to their irrigation business environment.
- Positive momentum should be developed as soon as possible to break any initial inertia.
- To assist in developing a network of stakeholders for particular projects the Management Committee could consider joining or supporting technology transfer programs being funded by other R&D corporations.

3.2 Existing programs

The irrigation program is currently supporting a range of projects. If it is not already planned, the review process for National Management Committee projects should look at the success of the project from the view point of the target group. The review should aim to find out what knowledge potential users of techniques or equipment irrigators have. Answers to the following questions should be available to researchers and to the program management committee when a project has been completed.

It is important to note that making results and information known to the industry should be an integral part of any research project.

1. **Awareness of the project**
Do irrigators have knowledge of the project itself, the goals of the project and the results of the project?
2. **Relevance of the research**
Are results being used? If they are not being used, why not? Have irrigators been asked about the research? How are the results prepared and presented?
3. **Modifications to the project**
Have follow up projects been developed? What communication strategies are in place to promote and publicise the results of successful projects? Are there changes which could be made which will improve the adoption of any successful techniques or technologies?

The answers to these questions could be obtained through simple questionnaires, which need not take up a great deal of the irrigators time. It is also critical that irrigators and other stakeholders are involved in the research process if the rate of technology adoption is to be improved. In our view it is better to spend time getting their involvement and support for the process than spending time demonstrating the success of a particular technique to the research community.

3.3 Identifying New Projects

Because a different methodology is proposed for technology transfer programs supported by the irrigation management committee, it is important that any new projects have a good chance of success and therefore should be relatively modest. When the process has been shown to be successful the scope of projects can always be widened. Two strategies could achieve this: (i) a project could be developed for a discrete geographical area, for example a specific irrigation area or (ii) a project could be developed to introduce a particular technology.

The authors of this paper do not consider it the role of this paper to identify specific projects for funding. It is the intention to present a methodology which could be used by the management committee. The paper also does not purport to provide a methodology for judging the potential benefits that might accrue from funding particular projects. So the projects described below are to exemplify the general points made and not included as recommendations.

It should also be emphasised that the PAM model represents a process; its intention is to develop a positive environment for change amongst the groups impacted by the changing use of technology. The catalyst for inducing such change will vary from location to location and from client group to client group. In one location the successful catalyst could be the local demonstration of a particular device, for example, automatic bay gates for flood irrigators, in another a change in water prices might prompt flood irrigators to adopt a range of strategies from improved scheduling and surge irrigation to conversion to a fully automated micro-irrigation system.

It is proposed that the management committee look for ways to introduce the PAM process. Three projects are outlined below which are a way of achieving this.

PROJECT A

Develop an inventory of technology and techniques that if more widely used could lead to significant improvements in irrigation efficiency. This project would be directed to the "technical experts" in the scientific community. This project could be described as trying to define what tools there are available to improve irrigation efficiency. Key information about each technique/technology would include: current use, limitations on use, potential benefits compared to average current efficiency in the industry in which it may be introduced, and any other key data which helps to characterise its potential performance. It is important that in developing such an inventory that the commercial sector be involved. The data collected should detail the practical factors affecting the technology's use.

PROJECT B

Identify an irrigation area that is the subject of much pain for change. The project should attempt to bring together the stakeholders in that area to develop a strategic action plan for the irrigation area. Some models of this type of project may exist. It is suggested that the area be relatively small and produce only a few commodities so that the stakeholder group is relatively small. Such a project would depend on attracting support from other stakeholders such as processing plants and other R&D corporations.

PROJECT C

Select a technology or technique and make it the focus of a project to have the technology more widely adopted. The technology should have easily demonstrated potential benefits and be as technically easy to understand as possible, so that there are few technical barriers to entry. Such a project could begin with asking irrigators what they thought about that particular technique or technology, why they didn't use it, what would make them adopt the technology? All of the potential beneficiaries need to be involved in the management and operation of the project.

It is proposed that the Management Committee address the technology transfer issue by supporting if possible all three types of project. Project A will assist in summarising and widening the knowledge of irrigation technology, both amongst the scientific and research community and in the wider irrigation industry.

Project B would involve the establishment of a new PAM project. The emphasis on this project is on establishing the process within a specific community, involving an easily identified group of stakeholders. The CARE programs in South Australia as described in Appendix 2 are similar and could provide useful information for the successful implementation of such a project. The project is deliberately not focussed on any particular technology, since it is believed appropriate technology for improving irrigation efficiency should be identified by the stakeholders.

Project C in contrast should be focussed on a particular technology, selected by the program management committee. Ideally the technology will have easily demonstrated benefits and some degree of adoption by the industry already.

4. Summary of Strategies for Change

The authors were given the brief of answering a number of questions relating to the slow adoption of improved technology and techniques by the irrigation industry.

Rather than answer each specific question the authors have highlighted the need for a different perspective on the technology transfer process. We contend that there are no simple answers to the eight issues raised; answers will vary from location to location and industry to industry. However it is clear that a universal prerequisite for successful change is the support and involvement of all stakeholders. Accordingly strategies are proposed which are designed to include stakeholders and to promote the adoption of a mechanism or process for change rather than recommend specific strategies for promoting particular technologies.

Since the irrigation program is already funding some R&D projects, it is proposed that stakeholders be involved in the review process. It is especially critical that irrigators are involved if they are the intended users of the improved techniques. Some specific suggestions are made as to how this might happen.

Three types of new projects are proposed;

- a) An inventory of technology as a means of highlighting what water use efficiencies might be possible.
- b) Location based projects focussing on particular irrigation areas.

- c) Technology based projects which aim to improve the rate of adoption of particular technology.

All of these projects should be managed so that all stakeholders are as involved as possible and see real benefits in a successful outcome.

5. Technology Transfer Expertise

All State Departments of Agriculture or Primary Industries have extension staff.

The following tertiary institutions also have particular expertise:

- The University of Queensland
- University of Melbourne
- University of Western Sydney (Hawkesbury)
- Charles Sturt University
- University of Western Australia

In addition to this list commercial organisations have frequent contact with irrigators, particularly when they are attempting to introduce new products into the market place. This sector is an important link in the industry network.

APPENDIX 1

Keys to Successful Industry Development

Stephen Coats, Bonlac Foods Ltd, Shepparton, Victoria

Keys to Successful Industry Development

Stephen Coats

Bonlac Foods Ltd Shepparton, Victoria.

Summary

Successful education and industry development is heavily dependent on the recognition and recruitment of all key stakeholders and developing a process whereby those stakeholders gain ownership of industry developments. The procurement of a clear understanding of the motives, needs, constraints of the participating parties is essential ie. we must know the client.

The Paper

In 1975 the Dairy Industry in Northern Victoria ran a Conference in Shepparton called the "Large Herd Conference".

It was organised by the Department of Agriculture with a few key farmers being heavily involved. The Conference was a huge success and some \$5,000 additional funds were generated above budget. When this was known the Department Officers were grabbed by the farmers and told not to put that money in Department coffers...or we'd lose it. "How about whacking it in an Investment Deposit" the farmers said.

They did and the investment grew and became an industry "slushfund" for the development of extension in Northern Victoria...under the control of farmers.

The funds and the original organising committee grew to encompass representatives of all the stakeholders in the dairy industry. Farmers, Factories, Government Departments, Victorian College of Agriculture and Horticulture, Herd Improvement Organisations were all represented in a group of about 12 people.

In the late 80's the Group was incorporated and became known as the Northern Victorian Committee for Dairy Industry Development (NVCDID). Amongst other things our charter specified that the Chairman would always be a farmer.

It was in and around this period of incorporation that several factors caused this Committee to once again become very active and focussed on the role it had assumed.

The industry had just had a severe downturn in milk price. Further to this Education and Research facilities were still less co-ordinated than Northern farmers would have liked and we were in an environment where these resources were becoming more scarce by the moment.

If the industry was to prosper it needed to co-ordinate its resources, develop an industry objective and put very relevant, farmer driven programs on the ground. The NVCDID was the logical vehicle to pull "things" together.

We were convinced of the need and that industry co-ordinated, high quality, needs driven projects would be funded...even in a difficult economic environment. This has proven to be the case.

As a result of the upsurge in activity of the NVCDID a major conference was held in Shepparton in June 1989. It was called "1992 and Beyond" and it was designed to examine issues which may restrain the development of our industry in the coming years and to identify opportunities within the industry.

Developing the ability of farmers to set relevant long term farming and family goals, and to carry them out, the need for "off peak" milk in our manufacturing facilities and the potential for increased pasture utilisation in mid and late lactation were identified as key issues.

The industry now had to take these key issues and devise programs, on the ground, which could tackle them.

The educational program "Operation Mid Lactation" was one result of these deliberations. Right from its inception it received physical and financial support from right across the industry and has since become some sort of model for how such programs can develop.

Importantly, because the stakeholders in the industry had been a part of the development of the NVCDID and the Conference, they had real ownership of and commitment to the actions that were arising. Also, because there was a cross-section of people involved and a strong end user influence (ie. the farmers and industry themselves) OML did not remain, for long, as solely a milk production program. Issues of family, goal setting, breeding, communication were all tackled over the two years of the program as the need for diversity in the program became clear.

One simple vision, at the time of development of OML, was to have, as part of Operation Mid Lactation, 600 dairy farmers walking across paddocks each month, in groups, discussing the issues that concerned them. This discussion group format was a powerful engine for change and subsequent analysis has shown us that farmers valued this component of the program particularly strongly when it came to unravelling more complex management issues in their mind. The combination of seeing other people's situation and having interaction with numbers of people grappling with similar problems in a similar environment helped them navigate through the complexity involved in certain management options.

Indeed we were seeing, and are seeing more and more clearly now, that the critical issues which are concerning farmers about the future are not single item technical issues such as the "correct slope for a bay" but how they can incorporate all the information they have into a cohesive plan for their future. They see access to information as easy; access to problem solving mechanisms as daunting.

However, getting back to Groups. We needed to provide a framework for these Discussion Groups to work. Elements required were leadership, a needs driven and hence relevant program, an extension tool to provide a central theme (ultimately the Milk Production Target Graph), continual feedback and motivation and someone (ultimately) to be the General and hold it all together. How could we do all this when resources were shrinking rapidly?

For example, we needed 60 group leaders. We only had 6 Departmental staff. We therefore decided to recruit and train our Group Leaders from the farming community and service industries eg. Herd Improvement.

We did this by taking 70 selected people to a retreat and, over several days, discussing with them our overall objectives and discussing group techniques and discussing better ways of moving relevant information. We also had refresher meetings. These Group Leaders went on to perform their duties admirably and became, in our analysis, the most influential leaders we had. They have now formed the core of a Group of farmers who are currently taking our industry development one step further.

In essence the whole OML program worked well. It was needs driven, benefits were tangible and expressed in farmer terms, communication within the industry of progress and developments was a key issue and was adhered to religiously, and there was a "product champion" who was always taking an overview and driving the process on...and the program had an end. It was our view that we needed a goal, to initiate a sustained effort over a defined period of time, so that everyone knew the process would ultimately conclude. It had a full stop.

So what next? Operation Mid Lactation and all the activities it spawned did conclude and we estimate we increased resources which were providing motivation and information into the industry by well over 5 times during this period.

We are now left with a nucleus of people who have been successful and can see that we all have a role in facilitating individual and group learning.

But did we get it really right? Our analysis of the work did show that although we tried to develop relevant programs, and largely succeeded, that some aspects of these programs were too production oriented and were frightening people.

They were scared of the implications of what was happening. Do I really have to go harder? I'm under pressure now! I'm not sure if I want to stay with this OML as I'm not sure I'm clear in my mind about where it's all going.

So did we really get close enough to our clients? With this in mind the Group has started again and tried to pin down the fundamental issues concerning our stakeholders in the Industry.

To begin this process a workshop was held last season where a professional facilitator worked with 100 industry people to have a fresh look at things in the light of OML and to determine what were the key issues of concern to the dairy industry in the next 5 years.

The aim was to use this information to help guide research and extension and community activities. The result was clear. Four main areas of concern cropped up: People, Environment, Production, Animal Health.

To flesh these areas out further the industry has undertaken some DRDC and Departmentally funded Market Research into how farmers perceive two critical issues. Water management (specifically drainage) and the immediate dairy industry future, that is, the next 5-10 years.

The results have been very illuminating. With respect to water management it is clear that the benefits of better drainage we are often espousing as Extension Officers mean very little to most of our farmers. It is possible that, for the past 25 years, and during OML, the great majority of our writings have fallen on deaf eyes.

For example, when asked, farmers viewed the advent of faster watering as threatening as it ultimately means that the water will only accumulate in the low spot of the farm faster than it does now. So what's the advantage? When asked about the effect of watering speed and drainage on feed quality the answer was "I've tried it but little effect". When this was chased further the emerging understanding was that pasture was usually only inspected on a regular basis near the outlet...where drainage is often better anyway. When asked about the advantages of having a re-use system the farmers often said "The principal advantage was to get the extra dirt you need during a lasering program, for example for tracks". When asked what drainage was farmers were unsure, but thought it was probably having a farm with access to an outlet.

So, Extension Officers (me!) write that we should have good drainage, water faster to achieve better pasture quality and have a re-use system to harvest excess water.

That is good but farmers can read the following, particularly if the access to labour is restricted and this is a key constraint on their farm.

"I must buy a farm with an outlet. Water faster to have problems more quickly and gain no advantage in pasture quality yet have to put in a re-use when I don't need the dirt!"

Did we clearly identify the correct benefits of improving our irrigation efficiency? Have we missed the point and not recognised that, to adopt this new technology, issues like labour input and reduction of crisis points on the farm was uppermost in people's minds?

A discussion of salinity highlighted areas where there was confusion, for example, around issues such as water table.

When questioned many farmers suggested they don't have a watertable...although they are worried about it and obviously, as we read so much about it, it is something to be concerned about. Those same farmers did have, however, dams that "naturally refill" and had trouble with the stump holes at their new house filling with water. One fellow said "So you are telling me I've got a high watertable plus wetness in my stump holes to worry about". Two problems instead of one!

In the Shepparton area there was an awareness of salinity and water control issues, and understanding of potential threat, but people weren't necessarily acting on it. At Cohuna, where salinity is generally seen as being worse, it was recognised that salinity was a problem, that there were management options, and that you could improve your situation. People had also come to grips with the idea some land might have to be taken out of production.

It was as if people go through the grieving process with salinity. Denial is the first reaction, followed by frustration and perhaps anger and then rationalisation and discussion. This eventually leads to acceptance and then action. Perhaps the Goulburn Valley is up to the rationalisation and discussion phase whereas Cohuna has progressed to action.

Conclusions

This document contains a number of points I would now like to try and cohesively summarise. They include:

1. Industry development programs are possible and can be exceedingly powerful but need to be relevant, client driven and well organised.
2. Success in developing an overall industry program depends on all stakeholders participating in the development of and having ownership of the direction and is very dependent on the development of a "product champion" who can push and develop the direction. In our case this has been a couple of people, one of whom is a politically unaligned farmer.
3. Relevant programs which are supported across industry and are developed by end users are generally easily funded and can produce a significant increase in resources eg. staff. Also, it is clear that a very valuable pool of people exist in the farming and service industries whose skills can be harnessed to effectively increase our available resources.
4. To better understand client needs, understanding and constraints Market Research should become more relevant as we have less Extension people directly in contact, on a daily basis, with their clients.

Also it is important to realise that the farmers we deal with, no matter how good they are, are often failing to truly represent the wide cross-section of farming views. It is, quite simply, almost an impossible function to fulfil.

5. We must work hard at developing communication techniques which allow farmers to see issues and become involved in problem solving and learning rather than technology transfer.

As the problems we seek to address become more complex we must invest in more innovative and interactive extension techniques.

APPENDIX 2

CARE

(Community Action for the Rural Environment Program)

This MDBC project run by the Community addresses both dryland and irrigated agriculture. The irrigated component aims to promote and support community participation in water resource management, at both a district planning level and the adoption of on-farm improved practices.

An important initiative has been the development of training schools for irrigation farmers, using technology developed through the ICMS (encompassing soils, irrigation systems and scheduling). These schools have been developed and implemented with the assistance of TAFE, are accredited through the TAFE system and comply with the competency-based training format of the National Training Reform Agenda.