Knowledge Management in Irrigated Cotton and Grains – Stage II

Report of Findings

David Wigginton and Peter Smith
NSW Department of Primary Industries

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NATIONAL PROGRAM FOR
Sustainable Irrigation


GRDC
Grains
Research &
Development
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Australian Government
Cotton Research and
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Cooperative Research Centre for
IRRIGATION FUTURES


NSW DEPARTMENT OF
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Cotton Catchment Communities CRC


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1 Executive Summary

The *Knowledge Management in Cotton and Grains Irrigation* project was undertaken in two stages:

- The first stage of the project identified the major components of the irrigation information and knowledge transfer and access system that existed in the Cotton and Northern Grains Industries. This allowed targeting of key areas for improvement or enhancement of the whole irrigation knowledge system.
- The second stage attempted to develop and implement components of an improved and enhanced knowledge system and to determine their effectiveness. This second stage has identified which strategies might be most effective at successfully introducing these components as well as a number of barriers.

Knowledge is a complex concept. It is common to view knowledge as including information, experience, context, practical application, instinct and a variety of other interacting parameters. Knowledge is also commonly viewed as an important resource which can be difficult to manage and share, due largely to its complex nature.

This project was developed in order to improve the management of irrigation knowledge and thus impact upon the rate of adoption of improved irrigation practices. Integral to the success of this objective is the operation of the irrigation extension program in place, as it is ultimately this program which will drive the outputs of this project in the long term in order to effect practice change and manage irrigation knowledge in the process.

Using the five models of extension adopted by the Cooperative Venture for Capacity Building, current irrigation extension was found to focus largely on the Technology Development model and, to a lesser extent, the Information Access model. The Group Facilitation/Empowerment, Programmed Learning and Consultant/Mentor models were not used to any great extent.

As knowledge is a highly integrated concept, it is suggested that improved knowledge management will stem from a more balanced approach to extension. This balance has been altered somewhat during the course of this project as the training developed has improved the use of the Programmed Learning model, and the consultant support program has improved the use of the Consultant/Mentor model. The use of the Group Facilitation/Empowerment model needs to be much greater, especially since knowledge is best shared through action and participation with others.

The training developed by this project is an innovative workshop approach which is designed to integrate several of these extension models. Training delivery to date has been positive and suggests that this new approach is effective and desirable to the target audience. It is likely that the impact of the training will improve significantly as more participants take part and the value of competency based training leads more participants to obtain nationally recognised qualifications or certification.

The consultant support program was developed in order to assist existing consultants to deliver irrigation services. This program has met with varied success across different regions due to a number of factors. Of particular note, where the program has been supported by specifically targeted incentives, progress has been significant. Seasonal conditions have impacted considerably on the level of involvement of consultants in some regions; however the progress made elsewhere, and the impact that the program

has had on selected consultants and extension personnel, suggests that this format can be progressed and improved into the future. Indeed the Cotton CRC Water Team is intending to continue this aspect of the project over the next summer season, although additional resources will be needed to do so.

A substantial proportion of project staff time has been directed towards the development of a range of information resources including case studies, media articles, a website and updating of 'WATERpak'. Whilst many have either already found use or are likely to be useful in the future, it is difficult to measure the impact of many of these resources or the return on investment. Considering information resources are only one valuable component of the knowledge system, it is recommended that future resources be produced to satisfy a definite need rather than to satisfy a project requirement.

1.1 Recommendations

- That the way irrigation extension is delivered continue to evolve to better reflect the mix of extension models which will maximise knowledge sharing and improve practice change. In particular, a participatory action learning approach to group activities should be encouraged.
- That irrigation extension projects be better structured to allow team members the flexibility to undertake extension activities that reflect these models
- That irrigation extension staff be offered training in relevant extension techniques, especially participatory action learning
- That irrigation extension projects be differentiated from water use data collection projects. Collecting useful water data is time consuming, detracts from the ability to deliver extension outcomes and does not provide return on investment in terms of practice change.
- That the flexible, innovative workshop training model be extended to other industries and regions
- That a planning workshop be developed to support industry or regulatory planning programs, and include all land, water and NRM issues (not only irrigation). This workshop should be aligned with National Competencies.
- That development of an irrigation system selection workshop be considered that supports irrigation decision making processes. It could be modelled after the framework developed by DPI Victoria www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/lwm_farmwater_efficient_irrigation_wheel
- That the Consultant Support Program be expanded and delivered over a number of seasons to establish its value and provide a mechanism to deliver extension through the Consultant/Mentor model
- That incentive programs which support consultant capacity building should be encouraged and some consistency in their availability across all regions should be pursued
- Other projects that support capacity building of consultants should be investigated, such as funding for consultants to collect water use data thus providing industry data as well as data useful for on-farm decision making and the National Water Initiative storages project
- Future Knowledge Management and Extension projects should be developed with significant flexibility in terms of the quantity and type of information resources produced, as these form only a component of the entire knowledge system and flexibility will improve the effectiveness of use of project resources.

Table of Contents

2 Introduction

This report summarises the major findings which have arisen from the project *Knowledge Management in Cotton and Grains Irrigation*. This report should be considered in conjunction with the detailed evaluation report prepared by Coutts JR consultants.

The lessons learned are detailed and recommendations provided where appropriate. They are discussed under the following headings:

- Knowledge Management concepts and Extension methodology
- Training (Cotton and Grains Irrigation Workshop Series)
- Development of Commercial Irrigation Services (Consultant Support Program)
- Development of Information Resources

3 Knowledge Management

Knowledge is fundamental to improving the competitiveness, responsiveness and levels of innovation that we see in industries (Callan et al., 2004). A frequent misconception is that knowledge can be equated with information; however Davenport et al. (1998) describe knowledge as information combined with experience, context, interpretation, and reflection.

Indeed the knowledge system (particularly how knowledge is shared and used) depends upon the way in which information is applied and will vary depending upon the characteristics of, and resources available to, those who are applying it. Given that much of our effective irrigation knowledge is not only contained within the products of our research undertakings, but also within the practitioners, farmers and service providers of the industry, it is imperative that we are able to effectively access and share this collective knowledge resource.

However knowledge is not an abstract, tangible thing that be exchanged between people without any mediation, transformation or interpretation (Campbell, 2006). Therefore industry extension programs need to facilitate opportunities for knowledge sharing and transfer, although this is a significantly more complex process than is often allowed for in current irrigation extension programs.

3.1 Extension models

As with most agricultural industries, extension forms a core component of the practice change process within the cotton and grains industries. Within the context of irrigation, both the NSW and Qld Departments of Primary Industries employ a number of extension officers who have responsibility to deliver irrigation extension programs covering both cotton and grain crops. These staff operate as a unit under the banner of the Cotton Catchment Communities CRC Water Team.

There are many descriptions of various extension approaches, although those proposed by Coutts et al. (2005) have been adopted as a de facto Australian standard by the Cooperative Venture for Capacity Building. The five models proposed are described below.

The Group Facilitation/Empowerment model

Focuses on increasing the capacity of participants in planning and decision-making and in seeking their own education and training needs based on their situation.

The Technology Development model

Individuals and groups work together to develop specific technologies, management practices or decision support systems which will then be available to the rest of the industry or community. It often involves local trials, demonstrations, field days and on-site visits.

The Programmed Learning model

Specifically designed training programs and workshops are delivered to targeted groups to increase understanding or skills in defined areas. These can be delivered using a variety of modes and learning approaches.

The Information Access model

Individuals and groups can access a broad range of information at a time that suits them. It can be based in a library, information centre, on a website or other centralised location.

The Individual Consultant/Mentor model

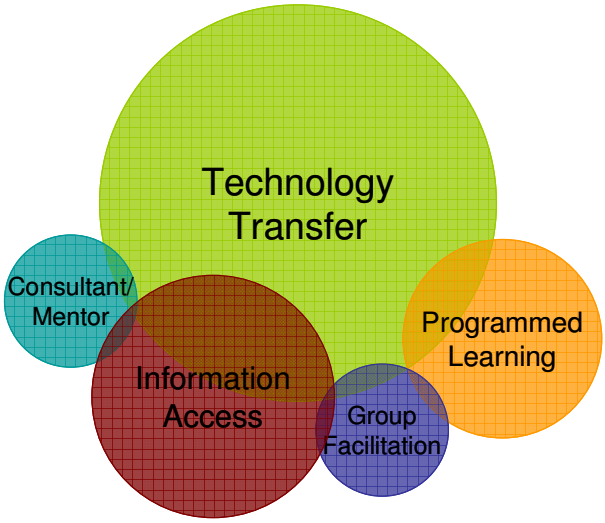
This model is about individualised one-on-one support. It may be a technical expert visiting and providing advice, diagnosis and recommendations. It may be an ongoing facilitator-mentor relationship which provides a sounding board for decision makers.

Whilst it is typical for extension projects to employ these models in combination, the effectiveness of the extension program in driving change, and in particular encouraging knowledge transfer, will depend upon just how they are combined.

Within the cotton and grains industries, irrigation extension has been principally driven by the Technology Development model, with components of the other models sometimes used to support demonstrations of new technology or management techniques. This has been due to the generally highly technical and experimental nature of this work which requires large proportions of time to be spent undertaking on-farm measurements, and that irrigation officers have historically been viewed as technical experts more so than extension staff or change practitioners.

Figure 1 provides a representation of how irrigation extension has usually been undertaken to date. In this figure, the five extension models are represented by different coloured circles, with their size indicating the level of use of that model. The circles are also arranged to indicate that the Technology Development model has been the key directing how the other components might be used.

Figure 1 Representation of the model mix of existing irrigation extension practice (prior to Stage 2 of this project)



However extension programs within the cotton and grain industries that address topics other than technology have employed the other extension models with great success. One example is the formation and use of Area Wide Management groups and an industry training package to implement Integrated Pest Management practices which utilised the Group Facilitation and Programmed Learning models. Other examples are the grower groups functioning in many parts of the grains industry (e.g. Birchip, Grower Group Alliance, etc.) and the agronomic consulting model used widely in the cotton industry.

Indeed the first stage of this project identified how industry members wanted to access and share irrigation knowledge, and many components of the other extension models figured prominently. Some key observations included:

- Growers preferred personal contact, particularly one-on-one, to gain information about water management
- Agronomic consultants were a major source of information to growers and provided an opportunity to integrate knowledge from a number of sources, including other growers
- Growers and consultants learned best from each other, as this suggested the knowledge shared was practical and previously tested
- Information was best delivered in short, concise, practical and timely formats

These observations suggested that the Group Facilitation and Consultant/Mentor models would be effective with growers.

Furthermore, the information collected during Stage 1 relating to decision making, information sources and issues affecting water management produced a list of recommendations that relate to all of the five extension models:

- Development of training targeted at grower-managers and consultants (decision makers), designed in keeping with the key observations noted above
- A pathway for accreditation in irrigation management
- Development of case studies of growers' efficient practices and improvements

- Development of appropriate information resources, both detailed (WATERpak) and concise (media, newsletters, web, etc.)
- On-farm trials – to facilitate linkages and communicate
- Regional extension activities – groups, field days, information delivery
- Development of a business model for delivering commercial irrigation services

(More detail is available in the Stage 1 report by Callan, Christiansen and Harris 2004.)

3.2 New irrigation extension model

Progress against these recommendations will be discussed in detail throughout this report. However to achieve them requires an irrigation extension service that is sufficiently adaptable and unconstrained by the design of projects, internal and external agendas, etc.

While existing irrigation extension is largely focussed on the Technology Development model, all but one of the recommendations from the first stage of the project were focussed on the other models, as indicated in Table 1.

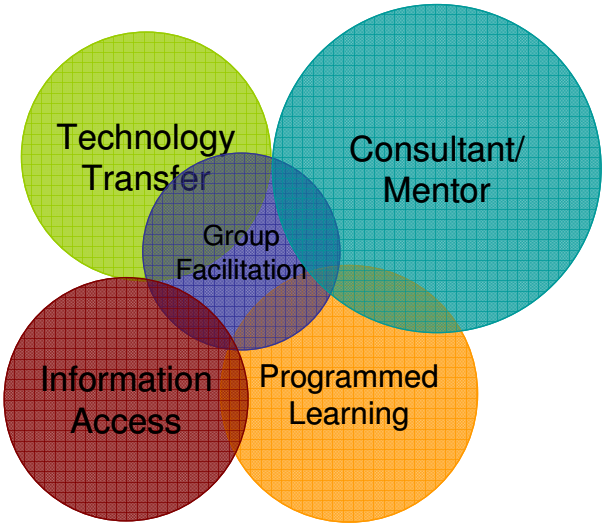
Table 1 Alignment between knowledge system components and extension models

System component	Extension Model
Irrigation Training	Programmed Learning
Accreditation Pathway	Programmed Learning
Case Study Development	Information Access
Information Resources	Information Access
On-farm trials	Technology development
Regional Extension	Group Facilitation/Empowerment
Commercial Irrigation Services	Consultant/Mentor

To deliver these therefore requires a different approach to irrigation extension. Where the majority of time was spent on trial work and technology demonstrations, more time needs to be allocated to building capacity within consultants and grower groups so that they can undertake these tasks themselves. The role of the extension officer can then move to providing technical expertise and facilitating opportunities for knowledge transfer to take place.

Using the same diagrammatic representation as before, Figure 2 shows how the various extension models might be more effectively mixed. In this representation, cohesive, self directing groups form the core around which activities which fall under the various models are conducted. These groups not only direct the types of activities and information they desire but also form the primary knowledge transfer mechanism.

Figure 2 Representation of the recommended model for irrigation extension



Irrigation training (Programmed Learning) serves two roles in this schema: 1) building knowledge and skills within grower and/or consultant groups, and 2) specifically supporting capacity building of consultants through tailored training, in turn enabling them to deliver support and knowledge to growers in their preferred one-on-one manner. Information resources would raise awareness and provide a method of promoting the group activities to the wider industry. Technology demonstration would be largely undertaken by the group members and supporting consultants, with technical assistance from extension personnel.

Unfortunately, there are some hindrances to implementing a model of this nature. The largest of these is the approach to structuring irrigation extension projects, particularly where the focus is on undertaking on-farm trial work and targets are attached to the nature and number of these trials. The excessive time often required for collecting data reduces the capacity for staff to undertake the important extension and knowledge transfer tasks.

In particular there should be separation of projects where the primary aim is to promote best irrigation practice from those which attempt to collect data for industry or other purposes. Accurate data collection is particularly time consuming, especially when data over an entire season is required, meaning every irrigation event must be measured. This volume of data is rarely necessary to demonstrate improved technology or management practice and is really a specific research or benchmarking activity. Recognition that this is not an extension activity is vital.

4 Training

A key component of the irrigation knowledge system identified during Stage 1 was the development of appropriate irrigation training. The Stage 1 report (page 40) recommended that this training should be:

- Practical
- Advanced
- Short
- Focus on one issue deeply rather than covering a lot of issues more generally
- Linked to farm trials or research findings

- A mix of different types of people and interests
- Linked to accreditation if this was to become a government requirement in the future

In developing Stage 2 of the project, it was assumed that the existing NSW DPI WaterWise course would form the basis of this training and would only require minimal adaptation to fit the Stage 1 recommendations.

However, the WaterWise material was not fully suitable:

- The WaterWise course was mapped to national competencies at level 3 and not at the managerial level expected of an advanced course. The Cotton and Grains Irrigation Workshop Series was to be targeted towards decision makers and managers which required mapping to national competencies at levels 4 and 5.
- The WaterWise course was designed to be delivered as a full or partial four day course, generally held in the classroom.
- The recommendation from Stage 1 required training to be practical 'hands on' and short in duration
- The WaterWise course, while successful, was more general in nature, while the recommendation from Stage 1 was to cover specific issues in detail.

4.1 Structure

The Irrigation Training Group (ITG) identified that a new training structure would be beneficial. Rather than producing a conventional training course, the training developed under this project would take the form of a series of discrete, but related, workshops. The format as delivered had the following features:

- Each workshop was short. The aim was for each workshop to be approximately 3 hrs in duration which is preferred by participants, both in terms of their availability and their ability to absorb new information.
- Each workshop was practically focussed on a single topic. This allowed workshops to integrate on-farm trials and research into the delivery mechanism.
- The format was significantly more flexible. Individuals were able to attend those workshops that were most relevant to them, and the order in which workshops were attended was not fixed.
- The format enabled better integration of adult learning principles. Workshops were conducted 'in the field', an environment in which most participants were very comfortable, using real examples and data. Practical activities and assessment tasks were wholly integrated.
- The training could be marketed as grower workshops or integrated into farm walks or field days, avoiding the stigma that is sometimes attached to formal training. Hence the word 'training' was removed wherever possible, and the overall program simply named the *'Cotton and Grains Irrigation Workshop Series'.*
- Workshops were used as a basis for bringing together mixed groups of participants to share knowledge. They became an integral mechanism for group formation and drive. Participants drove demand for the workshops, reflecting their needs more accurately and became comfortable with their fellow participants and the learning environment. It is hoped this will lead to improved knowledge sharing between participants over time. (For this reason, in contrast to Recommendation 4 in the Evaluation report, it is recommended that workshops are not run on an advertised schedule, but

are specifically facilitated according to the demands of different participant groups).

This format presented challenges for competency alignment and administration, but these were overcome in collaboration with the cotton industry's National Training Coordinator and the development of an integrated on-line administration database system.

4.2 Workshops

The workshop series first identified by the ITG underwent development throughout the project as illustrated in Table 2.

Table 2 Evolution of workshop structure

Original Workshops (May 2006)		**Interim Workshops (Feb 2007)**		**Final Workshops (Early 2008)**
Planning	Removed			
Benchmarking	→	Benchmarking and Water Budgeting		Benchmarking and Water Budgeting
Soils	→	Scheduling I		Scheduling I
Scheduling	→	Scheduling II		Scheduling II
Plant Water Relations	→			
Storage and Distribution Systems	→	Storage and Distribution Systems		Storage and Distribution Systems
Surface Irrigation Systems	→	Surface Irrigation Performance Evaluation		Surface Irrigation Performance Evaluation
	Created	Irrigation Systems	Removed	
Metering	→	Metering		Metering
Pumps	→	Pumps		Pumps

Early on in the development process, the ITG decided that the proposed *Planning* workshop would be inadequate - it would be too short to satisfy the clients' needs and not sufficient to meet any competency requirements. Hence this workbook should not be produced as a stand alone irrigation workshop. It is recommended that a planning workshop be developed which includes a wider variety of issues and suggested that it be an NRM focussed workshop which covers all of the requirements for Best Management Practice (BMP), Land & Water Management Plans (LWMP) and Environmental Management Systems (EMS). Such a workshop should directly support these planning processes as well as being mapped to the national competency RTE5604A.

At the ITG meeting in February 2007, the three workshops *Soils*, *Scheduling* and *Plant/Water* were combined into two *Scheduling* workshops which largely covered the same material. Similarly, it was thought that the *Storage and Distribution* and *Surface Irrigation* workshops were too large, so a new *Irrigation Systems* workshop was created. Thus eight workshops were planned at this point.

Upon revisiting the content outline *Irrigation Systems* workshop, it was evident that about half of the material had been included in the other workshops, so this workshop was considered unnecessary. There is some material that has not found a place within the other workshops, but is of insufficient quantity to warrant a separate workshop, as indicated in Table 3.

Table 3 Outstanding workshop material

Field Design and Layout	• Field Shapes • Siphon Sets • Calculating flow required to irrigate a certain siphon set
Upgrading system/ Designing new systems	• Systems (surface vs CPLM/Drip) • Economics

A more beneficial approach to this material would be an irrigation system decision making framework that would guide participants through the steps in deciding whether to upgrade existing systems or develop new systems. The Victorian DPI have developed such a framework for their local conditions (http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/lwm_farmwater_efficient_irrigation_wheel) Consideration should be given to developing something similar or approaching the Victorian DPI about modifying their framework to suit cotton and grain production.

This content was not originally considered by the ITG and hence not developed as part of this project.

4.3 Development

The largest issue faced during the training development was that many of the topics identified by the ITG were not covered adequately (or at all) by the WaterWise course. Table 4 indicates how the topics aligned with available material.

Table 4 Sources of workshop content

Workshop Number	Topic	Content
1	Irrigation Benchmarking and Water Budgeting	Sourced from WATERpak with new information written
2	Scheduling 1	Some soils figures and data from WaterWise; other information from WATERpak with new information written
3	Pumps	WaterWise and new material
4	Surface Irrigation Performance Evaluation	Mostly completely new material
5	Storage and Distribution Systems	Mostly WaterWise and WATERpak material
6	Metering	Modified from the IAL 'Know the Flow' Training Package
7	Scheduling II	Mostly new material, some figures from WaterWise

When coupled with the significant task of mapping the material to national competencies, the training development became a major undertaking, far larger than had originally been conceived. Competition for authors' time led to responsibilities moving back to fewer individuals, with development timelines subsequently needing to be extended.

While this delayed progress, the staged release of different workshops over a 12 month period has proven beneficial, with learnings from initial workshops able to be incorporated into later developments. This has resulted in an innovative training delivery model with effective practical activities and assessment tasks.

4.4 Alignment with national training

Traditional training programs have often been developed by starting with an existing national unit of competency and then producing material that satisfies the requirements for this unit. In contrast the Cotton and Grains Irrigation Workshop series was developed by first identifying the desired subject matter and then mapping the irrigation components of existing programs (Cotton BMP, LWMP) to the range of competencies that exist.

Hence, where a traditional training course is completely mapped to a unit of competency (or set thereof), the Cotton and Grains Irrigation Workshop Series is mapped to some components of a number of units of competency, as illustrated in Tables 5 and 6.

Table 5 Workshop Series alignment to four National Competencies

Competency		Workshop Code
RTE4603A	Implement an irrigation-related environmental protection program	2, 4, 5
RTE4605A	Schedule irrigations	1, 2, 4, 6, 7
RTE4609A	Implement, monitor and adjust irrigation schedules	1, 2, 4, 5, 7
RTE5604A	Develop an irrigation and drainage management plan	1, 2, 3, 4, 5, 6

Table 6 Workshops and codes used in Table 5

Workshop code	Workshop Topic
1	Benchmarking and Water Budgeting
2	Scheduling I
3	Pumps
4	Surface Irrigation Performance Evaluation
5	Storage and Distribution Systems
6	Metering
7	Scheduling II

The result of this mapping means a participant does not automatically achieve a unit of competency if they successfully complete a workshop. It is only after completing the relevant combination of workshops, as well as undertaking a separate whole of farm assessment task, that a unit of competency may be granted. Hence there are no initial Registered Training Organisation (RTO) costs associated with attending a workshop. A nomination by a participant to gain a unit of competency triggers RTO administration and assessment costs.

This approach ensures current participants are able to achieve the formal recognition if they desire. In addition, past clients of the workshops are able to utilise their workshop experience via an assessment process known as recognition of prior learning (RPL). Since all the workshops are mapped, the National Training Coordinator is able to provide documentation illustrating this alignment to allow individuals to gain the formal recognition in the future.

The online training data base aids this by providing ready access to this information for any participant. This web database allows regional deliverers of the workshops to enter details of participants, attendance at specific workshops and up load scanned images of activity sheets (RPL evidence) collected during the workshops. This data base is relational and can be interrogated for competency classification, allowing participants to obtain evidence for assessment at a future time. This project has developed a platform that could be considered a base for future industry training administration.

Alignment to national competencies means successful completion of the courses may contribute to a range of other qualifications and certification programs. These are outlined in Table 7.

Table 7 Alignment of competency units to various qualifications and certification programs

	Units included in Irrigation Workshop Series				Additional Units Required
	RTE4603A	**RTE4605A**	**RTE4609A**	**RTE5604A**	
Cert IV Agriculture (cotton or grain)	Non-listed Elective*	Listed Elective	Non-listed Elective*	Non-listed Elective*	9
Cert IV Irrigation	Compulsory	Compulsory	Compulsory	Non-listed Elective	8
Diploma Irrigation	Non-Listed Elective*	Non-Listed Elective*	Non-Listed Elective*	Listed Elective	9
IAL Certified Irrigation Manager (Cotton)	Yes	Yes	Yes	Yes	RTE4602A
IAL Certified Irrigation Agronomist		Yes	Yes	Yes	Choice of 3 other units
CCA Certified Cotton Consultant	TBC				
AIAST Agcredited				Yes	Choice of 7 other units

** Only 2 non-listed electives can contribute to the qualification. This is a qualification ruling - refer to the appropriate national training package for more details.*

RTE4602A: Determine hydraulic parameters for an irrigation system

5 Commercial Irrigation Services

The concept of encouraging the delivery of commercial irrigation services was born largely out of the information obtained during Stage 1 of the project. There were numerous observations that suggested that commercial irrigation services would benefit both consumers (growers) and suppliers (existing service providers). These observations are summarised below.

- The cotton industry in particular, but also many grains growers, already utilise an extensive network of private consultants to provide agronomic advice.
- Consultants provided services to growers in a one-on-one fashion, typically on a weekly or more frequent basis. This method of delivery was consistent with the observations from growers as to how they prefer to access information.
- Consultants tended to have long-term relationships with individual growers built upon a deep understanding of the grower's experience, risk profile, soil and water conditions, as well as high levels of trust.
- Because they service a number of growers, consultants were a key resource in terms of bringing in the experiences of other growers with similar issues. In this way consultants were already a key knowledge transfer mechanism.

- Agronomic consultants felt that many growers were more sophisticated than themselves when it came to irrigation. Consultants were the repository of agronomic expertise, but had not become the repository of irrigation expertise, so growers had looked elsewhere for this.
- Consultants believed that water has emerged as the new area of focus for them. At the time of the Stage 1 study (2004) Bollgard II cotton had recently been released and consultants anticipated that they would need to focus on other issues as the substantial proportion of time that had previously been devoted to checking for Heliothis would no longer be required. In effect there was some concern that Bollgard II would reduce the workload, and possibly income, for agronomic consultants.
- Consultants are generally paid for agronomic services according to the area of crop planted. Some forward thinking consultants were able to see that if they could provide irrigation services that saved water for their clients, then this water might be used to grow a larger area of crop. In this situation, there is potential for increased revenue from stand-alone irrigation service delivery and increased revenue from agronomic services.

Hence, it seemed logical that building the capacity of consultants to deliver irrigation services would satisfy their demand to expand into this market, as well as provide a key component of the irrigation knowledge system.

The concept of capacity building is often discussed, yet seldom defined. In the Australian rural context it may be construed as processes designed to help individuals or groups to improve their stock of human, social, financial, physical and natural capital (Macadam et al. 2004). When applied to the task of building the capacity for delivery of irrigation services, these stocks encompass an array of skills, knowledge, confidence, social networks, trust, tools, equipment and land and water resources. For these services to be delivered commercially, an array of financial considerations must also be met.

Following analysis of these various considerations, the issues that need to be addressed in order to develop a sustainable commercial irrigation service sector can be reduced to two main categories:

- The Product
  - Skills, knowledge and confidence within the individuals delivering services
  - Tools and equipment required
  - A range of services to deliver, matched to potential demand and with on-going deliverability
  - Recognised (standardised) procedures and processes
- The Business
  - An understanding of how irrigation services fit into their business
  - Social networks for expertise and support as well as client identification
  - Demand for services including client value for money, ability to pay and on-going (rather than one-off) services
  - Financial viability – capital costs, labour, return on investment, incentives to encourage investment

5.1 Developing the commercial irrigation service model

Initial development efforts were unsuccessful due to an inability to engage potential service providers as a collective, and the perceived lack of interest from most

consultants, despite the positive indications suggested during Stage 1. These issues will be discussed in further detail later in this chapter.

A revised approach, calling for Expressions of Interest from individuals or businesses to be involved in a Consultant Support Program, was tried successfully in July 2007. The stated aim was assisting consultants to improve their ability to deliver commercial irrigation services. This program was to provide training, advice, one-on-one support and relevant economic analysis to successful applicants to build their confidence to enable them to deliver a service that added value to their business.

Support would be provided by the local extension officer(s) in the first instance, with further support offered by the National Irrigation Knowledge Broker. Specific training, developed separately within this project, would be provided.

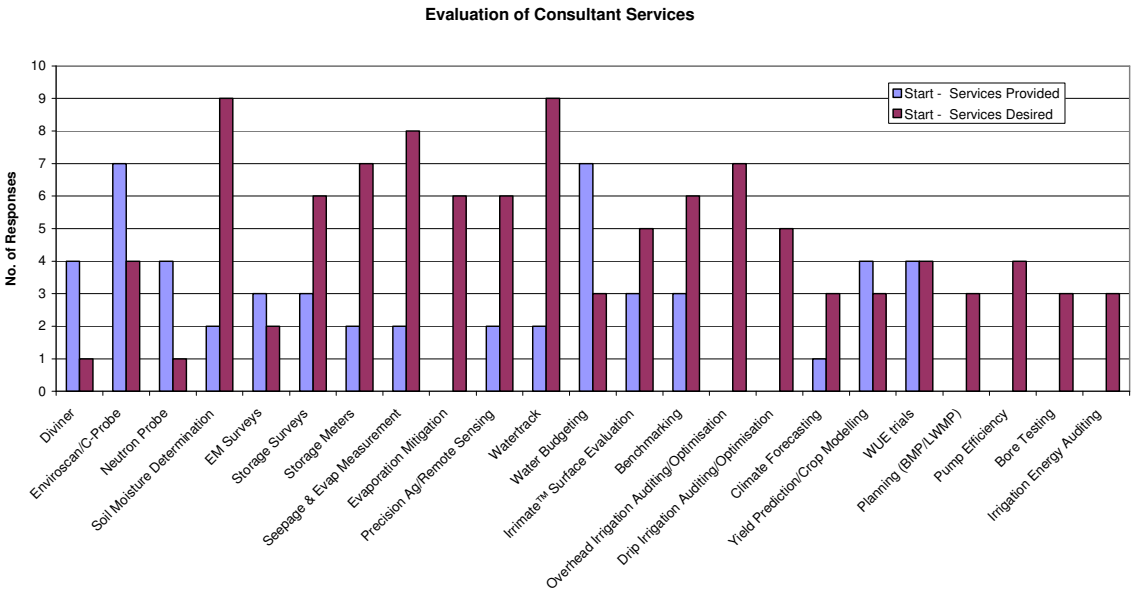
Whilst there was no target audience specified for the EoI, those who applied were all agronomic consultants. A total of 14 applications were received, and all of these applications were accepted. This represents a reasonable proportion (about 12%) of the agronomic consulting businesses within the industry, estimated at between 90 and 120.

The applications were spread across the industry with three in the Namoi Valley, two in the Gwydir valley, three in the Border Rivers/St George region and six on the Darling Downs. The Darling Downs consultants were included in initial meetings, but were facilitated separately in order to fit with another complementary project local to that region. One Darling Downs consultant subsequently withdrew from the program in order to work overseas, reducing the total number of participants to 13.

5.2 The Consultant Support Program

Many of the consultants had already been involved in the delivery of some types of irrigation services, mostly irrigation scheduling. Figure 3 shows the number of consultants and range of services.

Figure 3 The number of consultants who already delivered (blue) or wanted to deliver (red) a range of different irrigation services



The Consultant Support Program started with a meeting for all participants in Toowoomba in October 2007. This meeting was designed to get the participants together to share thoughts on services that could be delivered and to hear the experiences of those who had already delivered an irrigation service. Individual actions plans were developed that outlined the services that individuals wanted to focus on for the upcoming summer irrigation season (shown in Figure 3), and the specific support they required.

Participants chose up to three services, although most ended up focussing on only one or none. The main services that were of interest were Surface Irrigation Performance Evaluation (using the commercially available Irrimate™ system), centre pivot/lateral move assessment and management, storage measurement and metering, and WaterTrack™, a commercially available whole-farm water accounting package.

The support accessed mostly was initial training. In most cases, this training consisted of one or more of the irrigation training workshops. Key workshops included Irrigation Benchmarking and Water Budgeting, Scheduling I, Pumps and Surface Irrigation Performance Evaluation. Some participants also attended a Centre Pivot and Lateral Move workshop presented throughout the industry by the CRC for Irrigation Futures.

In addition to this basic training, some specific events were conducted as demanded. For example, consultants in the Gwydir valley attended a lateral move system audit and shown the process of analysing the data and formulating recommended changes to the system. Other consultants were directly supported with field visits to discuss or demonstrate pump testing, lateral move management, surface irrigation performance assessment or storage metering. Equipment was also loaned to a number of consultants so they could become familiar with using it and interpreting the data.

5.3 Results

The ability for consultants from all regions to actively participate in the project was substantially impacted by the seasonal conditions. Early in the season, during the planning phase (August – November 2007) most consultants were unsure of the extent of irrigation to be undertaken by their clients due to a severe lack of water. This meant that it was difficult to plan where and when certain services might be delivered as most growers had no water and could not guarantee that irrigation would take place.

Significant widespread rainfall during December stimulated sowing of an extensive area of dryland grain crops. As most consulting businesses had drastically reduced staffing levels due to drought, the consultants were extremely busy providing agronomic advice for these dryland grain crops, as well as those irrigated crops that had been planted earlier and were now able to be fully irrigated. A further constraint was the drought-induced lack of finance experienced by most growers for spending on things like new irrigation services. This resulted in many consultants either delaying, decreasing or ceasing their activity within the program.

5.3.1 Darling Downs

Results on the Darling Downs were better than the other regions. This was due to the complementary project that operated in this region. This project provided incentives to improve, delivered by the local regional body, the Condamine Alliance. The Cotton CRC provided funding to provide a part-time facilitator for the consultants in this region. Total funding was in the order of $150 000.

Because incentive money was available, consultants were able to justify the time they spent on delivering irrigation services as there was a guaranteed income stream, and growers were motivated to take advantage of the incentive money available. (Even with this situation, however, the incentive money was unable to be fully spent.)

The activity of consultants on the Darling Downs is summarised in Table 8. The participant who left the program has not been included.

Table 8 Service delivery by Consultant Support Program participants on the Darling Downs

Consultant	Activity
1	Has undertaken 7 surface irrigation evaluations and plans to undertake an EM survey and a storage survey.
2	Has undertaken 2 surface irrigation evaluations, has received in-field support to diagnose issues with a lateral move machine and is planning to be involved in a lateral move system audit training day.
3	Has undertaken 2 surface irrigation evaluations.
4	Had hoped to undertake some surface irrigation evaluations however these were interrupted by rainfall events. He is now planning to undertake an EM survey and a storage survey.
5	Has undertaken a centre pivot system audit and 3 surface irrigation evaluations.

5.3.2 Other regions

Participation across the other regions was limited in comparison, although many participants have increased their knowledge of the services they were interested in, and are now more aware of what is involved in delivery, even though they have not progressed to the point of delivery.

Activity within the program varied between the other regions. In some, all consultants involved were contacted regularly and numerous opportunities were given for direct support. In others, there was little ongoing contact with the consultants and few opportunities were presented.

Time commitments and lower enthusiasm of the consultants in these regions were factors, and varying levels of input from local extension staff contributed to these regional differences. Table 9 summarises the level of activity of consultants across the other regions.

Table 9 Service delivery by Consultant Support Program participants in other regions

Consultant	Activity
Namoi 1	Undertook a pump efficiency test with project staff
Namoi 2	Attended a Benchmarking Workshop and is keen to apply these techniques with his clients
Namoi 3	Was initially keen to run WaterTrack, but subsequently travelled overseas. Other consultants within this business attended Surface Irrigation Performance Evaluation training.
Gwydir 1	Increased his knowledge of Lateral Move irrigation systems by attending the CP/LM Training Course and hosting a field demonstration of evaluating a client's lateral move. He has subsequently re-evaluated the machine with his client and is working through further performance improvements.
Gwydir 2	Was in regular contact with local extension staff but not delivered any services. Other staff within the business have attended Surface Irrigation Performance Evaluation training.
Border Rivers 1	All Border Rivers consultants identified similar issues and met in December, but were too busy to become further involved as the season progressed.
Border Rivers 2	As above
Border Rivers 3	As above

5.4 Discussion

Information obtained over the course of this project has suggested that a commercial irrigation service sector would provide potential benefits to consulting businesses and growers as well as improve the irrigation knowledge system within the cotton and grains industries. However there are several challenges to establishing this sector:

- As discussed previously, the Stage 1 findings suggested that commercial irrigation services would be attractive to both growers (consumers) as well as consultants (suppliers). A gap between completion of the scoping study (November 2004) and implementation of Stage 2 (February 2006) caused the

program to lose momentum, and saw industry conditions change. Most notably, drought worsened (and would continue to do so over the life of the project) reducing the capacity of growers to pay for services and the capacity of consultancy businesses to supply services, particularly due to downsizing and scant availability of labour.

Furthermore, during this period of time, Bollgard II cotton was completely introduced, subsequently forming 80% of the Australian crop (Rossiter, 2006). During the scoping study, consultants predicted that introduction of Bollgard II cotton would dramatically reduce the time they spent checking and advising on Heliothis. Whilst this proved to be true, the majority of consultants have instead spent this time checking and advising on secondary pests, rather than expanding their services in areas such as water. Although the predicted widespread desire to deliver irrigation services has not occurred, the enthusiastic involvement of some in this program shows there is still potential for this.

- Uncertainty of water supply might increase the demand for irrigation services as growers attempt to make better use of the water available, but also might decrease their ability to pay due to tightening of farm budgets. Adding to this potential reversal, lack of water is viewed as a reason why water use efficiency cannot be improved by many growers and consultants, when this is the principal reason why it should be improved.

- Whilst the direct cause for the difference in activity on the Darling Downs was not objectively evaluated, it would seem that the incentive money available in conjunction with the support offered has resulted in a greater activity. This particular incentive program was novel, in that it only allowed funds to be spent on services delivered by consultants, thus providing the important component of financial capital that allows businesses to move into new lines of work. The Consultant Support Program was then in a position to build the human (eg. skills and knowledge of individuals), social (networks, support structures, contacts, etc.), and physical (e.g. loaned equipment, etc) capital required.

- One consultant who had invested in delivering irrigation services in the previous season indicated he was reluctant to share openly through the group process, particularly with other consultants within his region, because of a fear that his existing competitive advantage (more experience) would be reduced. Whilst there was validity to this argument, this also meant that he was unable to identify opportunities and synergies with the other local participants.

This is an issue of some significance. It would seem impractical for every agronomic consultant to provide the whole range of potential irrigation services, as there would be no economies of scale, and the resources and skills involved would likely be too great for every business to deliver these services profitably. However, there is also likely to be resistance to having a second-party agronomic consultant deliver irrigation services on a client's farm, due to perceived risk that the client would simply decide to obtain all services from a single provider. Hence if irrigation services become widely delivered there is likely to be consolidation of agronomic consulting businesses or synergistic arrangements whereby individual businesses deliver specific services to the clients of select partner consultants with reciprocal arrangements.

6 Information Resources

Information resources are a key component of a knowledge system, and their importance in fostering practice change is demonstrated through the Information Access model of extension delivery. However, as discussed earlier, information in itself is only one part of the knowledge system.

The first stage of the project produced a number of recommendations about how the irrigation knowledge system could be improved. In summary:

- Training
- Accreditation
- Case studies
- Information resources, both detailed (WATERpak) and concise (media, newsletters, web, etc.)
- On-farm trials – facilitate linkages and communicate
- Regional extension activities
- Commercial irrigation services

Of these recommendations, only two were specifically about the production and dissemination of information resources. However, a large proportion of the Stage 2 milestones were formulated around 'information' rather than 'knowledge' (WATERpak, Website, case studies, media articles, etc.). Whilst production of these resources is an integral part of a knowledge system, it is the knowledge system itself which should drive demand for the information resources.

While it is likely some of the information resources developed will prove to be important components of a knowledge system (for example, WATERpak which has been extremely valuable to many cotton growers and consultants, and is likely to be more so with the enhancement of irrigated grains information) there are others which have consumed significant project resources which have yet to demonstrate such value.

One example is the website www.cottonandgrains.irrigationfutures.org.au . This was a project milestone and was intended to be seen as impartially encompassing both the cotton and grains sectors of the project. It was desirable therefore, not to use an existing commodity based website. Whilst the independent evaluation indicates that the website is receiving some use, the web statistics show that this is limited, particularly in comparison to existing industry sites. The evaluation also revealed that awareness of the website within the industries is low despite numerous awareness raising activities.

Furthermore, input from extension staff, who ultimately will be required to maintain and update this resources, has been limited. Whilst this may change as the Cotton Water Team accepts ownership of this resource, the ongoing value is questionable given the range of existing industry and government websites and the power of modern internet search utilities.

While the use of this website may increase into the future, a more useful mix of resources would likely have been produced if the project had been designed to create the resources shown to be necessary as the project developed, rather than being constrained by overly specific requirements. If this had been the circumstance, it is likely that a separate website would not have been produced, and these resources could have been used to increase the participatory components of the extension service, which are crucial to provide opportunity for knowledge transfer but have not been adequately encouraged in the project as it has been delivered.

The experience of this project showed that the fairly precise specification of information resources and methods did not allow for movement in the industries, advances in technology, etc., and the result is outputs that are somewhat dated after requiring a large share of the project's resources.

Hence it is recommended that future knowledge management and/or extension projects be developed with the aim of achieving certain knowledge outcomes without stipulating the precise nature of the information outputs to deliver this result. Relevant information resource outputs will intrinsically form a part of the project activities and will be produced accordingly, but the project will be able to focus adequately on the other components of the knowledge system and not be detrimentally affected by information output delivery schedules.

7 Conclusions

7.1 Future knowledge management and extension

This project has identified some clear deficiencies with the mix of irrigation extension techniques and models currently in use and has suggested how this might be improved.

Progress has been made over the course of the project to address this, with some changes to practise achieved in several regions to differing extents. Most notably, the Consultant/Mentor model has been effectively implemented in a couple of regions, and it appears that extension staff in these regions have recognised the impact of this on both their workload and effectiveness. There has been a general increase in the use of the Programmed Learning extension model as training has become available from this project. However there is still a lack of Group Facilitation/Empowerment which would result from a greater focus on participatory action learning.

Maximum knowledge transfer will be achieved by providing local industry personnel with numerous opportunities to both share existing knowledge and build new knowledge together. It is imperative that such opportunities be provided in order to maximise learning as well as reach that portion of the industry that has been reluctant to adopt improved practices. It is this sector which is least likely to benefit from current extension techniques such as on-farm demonstration trials, but is likely to gain the most benefit from practice change.

The lack of attention to this need can be partially explained by the present focus on detailed technical on-farm trial work, with its attendant high consumption of resources (particularly time) but questionable returns in terms of practice change. Unless the demonstration is particularly new, it is likely that only the growers who participate in these trials will adopt the practice. Unless the wider industry is *actively* involved (i.e. in a participatory action approach, not simply field days, farm walks and the like), then the detailed knowledge developed from these activities will remain with the few who are active participants.

Given that the history of practice is mainly in the Technology Development and Programmed Learning models, training in participatory action learning and Group Facilitation/Empowerment techniques for extension staff would be necessary to speed the progression towards more effective knowledge exchange.

Recommendations:

- That the way irrigation extension is delivered continue to evolve to better reflect the mix of extension models which will maximise knowledge sharing and improve practice change. In particular, a participatory action learning approach to group activities should be encouraged.
- That irrigation extension projects be better structured to allow team members the flexibility to undertake extension activities that reflect these models
- That irrigation extension staff be offered training in relevant extension techniques, especially participatory action learning
- That irrigation extension projects be differentiated from water use data collection projects. Collecting useful water data is time consuming, detracts from the ability to deliver extension outcomes and does not provide return on investment in terms of practice change.

7.2 Training

The training developed as part of this project is innovative and effective and valued by those who have participated. While the Stage 1 report indicated that training would be sought, and the external evaluation suggested that only about half wanted to do more training, and many extension officers reported little or no demand, recent indications show that as more industry people complete the training, awareness and demand increases. It is likely that the full value of this training will not be felt for 3-5 years, as more participants have time to implement changes on-farm and become more aware of the benefits of relevant qualifications and certification.

The training has been designed to support demonstration trials and to be delivered to participatory action learning groups. Also, it has been targeted at both grower-managers and consultants in order to facilitate development of the Consultant/Mentor approach to extension. The full impact of this training is likely to occur only if it is fully integrated within the type of extension system discussed above.

Recommendations:

- That the flexible, innovative workshop training model be extended to other industries and regions
- That a planning workshop be developed to support industry or regulatory planning programs, and include all land, water and NRM issues (not only irrigation). This workshop should be aligned with National Competencies.
- That development of an irrigation system selection workshop be considered that supports irrigation decision making processes. It could be modelled after the framework developed by DPI Victoria www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/lwm_farmwater_efficient_irrigation_wheel

7.3 Consultant Support Program

It seems clear that the Consultant Support Program has the potential to build capacity within the commercial irrigation service sector. Whilst the program has met with challenges during its development phase, there have been demonstrated positive outcomes. Where irrigation incentives have been provided, the quantum of services delivered has been significantly greater, and these services have been delivered on a fee for service basis, establishing the commercial culture. It is recommended that similar incentive programs be encouraged and attention given to making their availability more consistent across all regions.

A range of services have been trialled across several regions by consultants with a mix of experience. Even where services have not been delivered on a fee for service basis, they have been trialled, or the first steps have been made that will allow delivery in subsequent years. In most circumstances, consultants have indicated that if nothing else, they are keen to better understand the principles so that this knowledge can be reflected in other parts of their business.

Extension staff have largely been supportive of the program. In most cases, activities align with existing extension project requirements and extension staff can see that they are able to reach a larger proportion of growers by working through consultants. Numerous extension staff involved in this project have indicated that they wish to see the program continue, and this is reflected in the Cotton Water Team's plans. This program provides a mechanism by which the Consultant/Mentor model of extension delivery can be encouraged.

Existing consultants should be encouraged to trial new services in coming seasons and new consultants be brought into the program. Demonstration trials and training workshops should be better integrated with the services being considered and more opportunities should be provided for participants to meet and share experiences. Coordination across regions is vital, particularly when attempting to integrate regionally delivered incentive programs.

Whilst in the past there have been concerns about public extension programs assisting private enterprise, it has been clearly demonstrated that in the cotton and grains industries, the private consultants are an integral part of the knowledge system. They provide one-on-one services, which is highly desired by growers and cannot be delivered by public extension with the current level of resourcing. A program such as this allows assurance that the knowledge being delivered by the consulting sector is consistent with extension service priorities and leverages the value of public extension resources.

Recommendations:

- That the Consultant Support Program be expanded and delivered over a number of seasons to establish its value and provide a mechanism to deliver extension through the Consultant/Mentor model
- That incentive programs which support consultant capacity building should be encouraged and some consistency in their availability across all regions should be pursued
- Other projects that support capacity building of consultants should be investigated, such as funding for consultants to collect water use data thus providing industry data as well as data useful for on-farm decision making and the National Water Initiative storages project

7.4 Information resources

A significant proportion of time from project staff has been directed towards the development of a wide range of information resources including case studies, media articles, website and WATERpak updating. Whilst most have either already found use or will undoubtedly be useful in the future, it is difficult to measure the impact of many of these resources, and thus the return on investment is difficult to quantify. Considering information resources are only one component of the knowledge system, whilst being an invaluable component, it is recommended that they are most effective when produced to satisfy a definite need rather than in order to satisfy a project requirement.

Recommendation:

- Future Knowledge Management and Extension projects should be developed with significant flexibility in terms of the quantity and type of information resources produced, as these form only a component of the entire knowledge system and flexibility will improve the effectiveness of use of project resources.

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