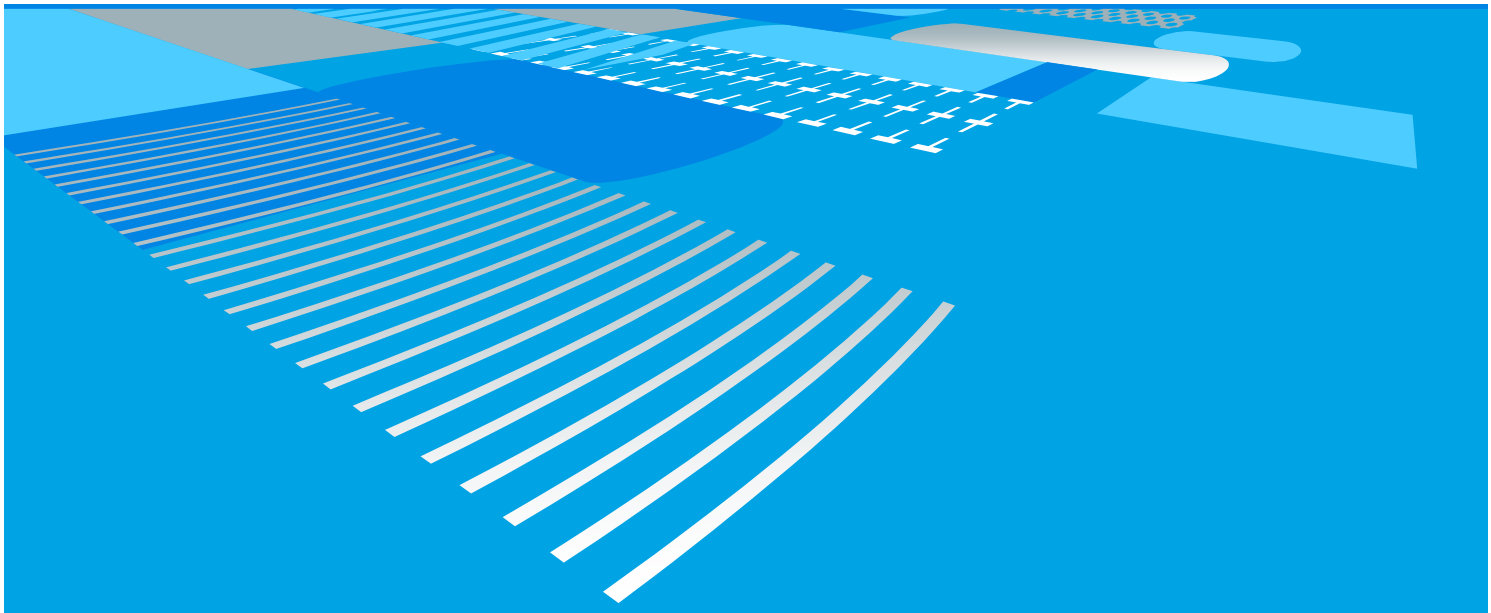
Final Report

Rural Water Use Efficiency 3

Best Practice Water Use and Irrigation in Irrigated Cotton and Grain



COTTON AUSTRALIA

Cotton Catchment Communities CRC

Queensland Government Natural Resources and Water

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PR09–2009

Acknowledgements

This report presents the results of the “Rural Water Use Efficiency 3: Best Practice Water Use in Irrigated Cotton and Grain” Project. This project (run from July 2006 to June 2009) was funded by the Department of Environment and Resource Management (formerly Department of Natural Resources and Water) through an industry partnership with Cotton Australia. The project has been delivered through the Department of Employment, Economic Development and Innovation, Queensland Primary Industries and Fisheries (formerly the Department of Primary Industries and Fisheries) as part of its partnership with the Cotton Catchment Communities CRC. With this funding and the collaboration of all parties this project would not have been the success it has been.

This is the third phase of funding provided by the Department of Environment and Resource Management (following on from the Rural Water Use Efficiency Initiative and the Rural Water Use Efficiency 2 project) which has had a significant impact in delivering improved water use efficiency within the Queensland Cotton and Grain Industries since 1999.

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Introduction

The purpose of this report is to review the success of the Rural Water Use Efficiency 3 Project.

The over arching targets for the RWUE3 project were:

- Industry with increased use of whole farm Water Use Efficient (WUE) practices; efficient use of available water resulting in an increased production per ML
- Industry able to demonstrate environmental credentials
- Improvements in on farm WUE have been documented with a target of 15% improvement in WUE by growers participating in RWUE
- 15% of irrigators achieving Irrigated Water Use Indices of 2 bales/ML

The key activities undertaken to meet the targets for the project were:

- Develop and deliver technical irrigation communication
- Established demonstration sites regionally
- Establish benchmarking tools and industry data
- Develop and deliver training workshops
- Perform and promote irrigation system evaluations]
- Develop and deliver technical irrigation presentations
- Promote and provide technical support to the cotton industry's BMP and NRM bodies regional priorities

Methodology

Secondary analysis of project records (Milestone reports, communication records, web statistics, workshop/project feedback were used to gather data from all activities, outputs and impacts)

Findings

Key Achievements – Summary

Table 1 summarises the achievements of the RWUE3 project against the targets set at the commencement of the project.

Table 1 Summary of RWUE3 achievements against targets

RWUE3 Targets	Achievements	Explanations
ACTIVITIES		
Communication		
95% (cumulative) of industry enterprises in the target districts have received information about improving water use efficiency.	69 separate articles 56 promotional items 121 to 5190 recipients – 100% of enterprises reached	
12 (cumulative) Case Studies developed and promoted through industry sources.	13 case studies communicated	
Demonstration Sites		
12 (cumulative) on-farm demonstration sites established	21 direct sites 15 indirectly	
6 irrigator tours (cumulative) conducted	8 (demo walks, farm walks and field days)	
Benchmarking		
65% of irrigators benchmarking their irrigation activities and adopting water use best practice	Benchmarking Workshop undertaken by 11% of growers and 16% of consultants. 80% indicated they would use benchmarking in future	Broader extent of benchmarking use unknown – release of myBMP will address this.
System Evaluations		
6 full irrigation system audits conducted	39 overhead systems 77 furrow evaluations	Furrow evaluations still to be entered into ISID
Training		
35 (cumulative) FMS workshops provided that provide advice on irrigation / water use best practice	29 training workshops 10 presentations	
50% of consultants and 40% of irrigators participating in formal WUE training activities	65% of consultants and 29% of growers	

RWUE3 Targets	Achievements	Explanations
Presentations		
No specific targets set	10 presentations to audiences of 16 to 300	
BMP		
Relationship between electronic version of BMP and WUE on farm tools determined	WUE Benchmarking Tool developed for use with electronic BMP	myBMP still to be released
Developing on-farm tools that interact with electronic Cotton BMP	ISID developed Data entered into IPART WUE Benchmarking tool developed	myBMP still to be released
NRM		
Report against on-farm achievement of regional NRM priority activities, defined with regional NRM groups	Worked directly with 103 irrigators to access $1,285m in funding through four NRM Bodies aimed at achieving improved WUE on-farm	
OUTPUTS		
Participation		
75% (cumulative) of producers have been directly involved in RWUE3 activities	Demo Sites - 58% growers and 26% consultants involved System checks - 34 growers involved Training Workshops - 29% growers and 65% consultants involved	Participation less than target due to the impact of low water availability on morale
USAGE		
70% of growers in each region have started to make changes in management practices and/or improved equipment and/or improved operations in relation to water management		No independent statistics available verify subjective observation that this target has been met

RWUE3 Targets	Achievements	Explanations
OUTCOMES		
Industry with increased use of whole farm Water Use Efficient (WUE) practices; efficient use of available water resulting in an increased production per ML	Available ABS Statistics suggest an improvement in IWUI of 27% from 2002-03 to 2006-07 – a result of adoption of more efficient irrigation practices and improved yields	
Industry able to demonstrate environmental credentials		Awaiting roll-out of myBMP – this will provide necessary data to demonstrate environmental credentials
Improvements in on farm WUE have been documented with a target of 15% improvement in WUE by growers participating in RWUE	Benchmark data needed to demonstrate this	Awaiting myBMP rollout and follow-up WaterTrack Rapid survey
15% of irrigators achieving Irrigated Water Use Indices of 2 bales/ML	Available statistics show an IWUI of 1.54 bales/ML in 2006-07. IWUI values > 2 bales/ML only recorded from drip irrigated sites. WaterTrack Rapid data suggests that a more realistic target for GPWUI is 1.39 bales/ML	Measurement of this target only possible with rollout of myBMP

Key Achievements - Communication

Information related to irrigation best practice was distributed to all growers (325 individuals) and consultants (113 individuals) within the cotton industry during the course of RWUE3. The communication channels used included:

- CottonTales Newsletter
- The Australian Cottongrower Magazine
- The Australian Grain Magazine
- Irrigation Australia Journal
- The Australian Cotton Conference Proceedings
- "More Profit Per Drop" e-newsletter
- Cotton and Grains Irrigation Website
- Regional Trial books
- "Darling Downs Waterchat"
- The CRDC Spotlight on R&D

There have been 69 separate articles and 56 promotional items published in 87 issues of the various communication channels. The number of recipients of the communication channels ranges from 121 to 5190 recipients.

A significant number of grain irrigators and consultants within the target districts also received this information. This information included 13 cases studies (exceeding the 12 required as part of

Key Achievements - Demonstration Sites

The RWUE3 team directly established 21 demonstration sites (exceeding the target of 12 sites) and were involved with 15 other sites established by consultants as part of the Consultant Mentoring project funded by Condamine Alliance.

These demonstration sites directly involved:

- 189 growers (58% of cotton irrigators)
- 29 consultants (26% of cotton consultants)

The 58% of growers directly involved in these demonstration sites falls short of the target of 75% of producers directly involved in RWUE3 activities. This was in part due to the impact of low water availability on morale during RWUE3. This reduced their willingness to participate. However, the low water availability has meant all irrigators have changed or are looking at changing their management practices and/or irrigation systems in response to this (exceeding the target of 70% of growers in each region have started to make these changes).

No irrigator tours were conducted during RWUE3 (failing to meet the target of 6 irrigator tours). There was no interest in such tours by irrigators when approached during RWUE3 – primarily due to limited water availability and low irrigator morale.

There were 77 irrigation evaluations undertaken at these sites with 17 articles, 5 field days and 3 presentations resulting from this work.

The participatory action learning model employed through the demonstrations sites resulted in all in co-operators measuring irrigation practices and implementing practice change on farm. The engagement with consultants was particularly valuable in developing their capacity to deliver irrigation services to their broader client base.

Key Achievements - Benchmarking

Significant effort was put into the development of benchmarking tools and training in their use. The review of WUE benchmarks in the Australian Cotton Industry identified the inconsistencies of past benchmarking data collected and highlighted the value of the benchmarking tools developed in collaboration with RWUE3. Firstly in standardising the water use indices reported, and secondly, promoting a number of tools available to irrigators to benchmark their water use on-farm.

The Watertrack Rapid™ survey demonstrated that WUE data could be collected in a short amount of time to provide a snapshot of the industry's performance. Thirty-six farms from Emerald to Hillston were benchmarked using the commercial WaterTrack Rapid™ averaging a GPWUI of 1.13 bales/ML where the top 20% of irrigators achieved a GPWUI 1.26 bales/ML.

There have been 59 participants in the Irrigation Benchmarking and Water Budgeting workshop (35 growers, 18 consultants and 6 others – this represents 11% of growers and 16% of consultants) to date. Evaluation of participants has indicated that training will be the best tool to provide growers with the confidence to benchmark water use on farm. The evaluation showed that all participants increased knowledge of the benchmarking process and between 75 – 80% of participants planned to implement some form of benchmarking on farm.

IPART and ISID benchmarking tools highlight the value of benchmarking irrigation system performance and demonstrated the need for further training and awareness of both overhead system evaluation and furrow irrigation evaluation to improve irrigation performance of individual systems.

The benchmark data from the demonstration sites established is presented in Table 2.

Table 2 Cotton benchmark data for the RWUE3 demonstration sites

	Gross Production Water Use Index (bales/ML)			
System	**2005-06**	**2006-07**	**2007-08**	**2008-09**
Surface	0.58 to 1.08	1.33 to 1.66		
Overhead	1.28	1.05 to 1.31		
Drip			0.9 to 1.1	1.20 to 1.30
	Irrigation Water Use Index (bales/ML)			
System	**2005-06**	**2006-07**	**2007-08**	**2008-09**
Surface		1.29 to 1.78		
Overhead				
Drip			2.3 to 2.6	2.7 to 2.9

Implementation of the myBMP will significantly enhance the uptake of benchmarking within the industry and provide good data on the irrigation benchmarks being achieved.

Key Achievements - Training Workshops

RWUE3 staff, in collaboration with the National Program for Sustainable Irrigation funded project: Knowledge Management in Irrigated Cotton and Grains Project, participated in the development of the Cotton and Grains Workshop Series. The workshops in this series are mapped against national training competencies so that participants could contribute towards obtaining a nationally recognised qualification. The seven workshops developed are:

1. Irrigation Benchmarking & Water Budgeting

2. Scheduling I
3. Scheduling II
4. Storage and Distribution Systems
5. Pumps
6. Surface Irrigation Performance Evaluation
7. Flow Metering

In addition, RWUE3 staff are developing an overhead irrigation evaluation awareness workshop. The pilot for this workshop is planned for mid-June 2009.

RWUE3 staff delivered 27 workshops to 202 participants (29% of growers and 65% of consultants). Evaluation of the workshop participants indicated significant increase in knowledge and skills, and a willingness to implement this new knowledge in the irrigation management practices.

Key Achievements - Irrigation System Evaluations

RWUE3 in collaboration with NCEA developed the Irrimate Surface Irrigation Database (ISID) and provided feedback on the development of the Irrigation Performance and Reporting Tool (IPART). Currently there are 100 furrow system evaluations from Queensland reported in ISID. The RWUE3 project has contributed a number of these current evaluations into ISID and is intending to contribute a significant number from the previous RWUE programs and those collected during RWUE3 (77 in total). The results of the 100 measured evaluations indicate an average application efficiency of 65%, with an application of 121mm resulting in deep drainage losses of 22mm and runoff of 26mm. Optimisation results in a reduced average application depth of 98mm (with average deep drainage losses reduced to 15mm and runoff reduced to 7mm) and an increased application efficiency to 81%.

There have been 46 overhead irrigation system evaluations conducted during the RWUE programs (39 of these during RWUE3). This is significantly more than the original target of six audits. The data collected indicate that only 9% of machines tested demonstrated excellent co-efficient of uniformity figures, and that 48% had poor to fair co-efficient of uniformities. These figures demonstrate the need for further extension effort to train irrigators in the importance of having overhead system evaluations conducted on existing machines and included as part of the commissioning of new machines. As a result the RWUE3 team are currently developing an overhead system evaluation awareness training workshop for the industry.

Key Achievements - Presentations

RWUE3 presented 10 Technical Irrigation Presentations to audiences ranging from 16 to 300. This included not only cotton and grain irrigators and their consultants, but also potential new irrigators in the Queensland Gulf.

Key Achievements - BMP

The RWUE3 team have provided technical support to Cotton BMP and have developed an Irrigation Benchmarking tool to support the implementation of the Cotton BMP Land and Water module. They also collaborated with the NCEA in the development of the ISID and IPART benchmarking tools. The RWUE3 team have aligned training activities including the Irrigation Benchmarking and Water Budgeting workshop along with all workshops and demonstrations to promote best practice to support the implementation of the BMP program on farm. The Cotton BMP has been under re-development throughout RWUE3 and will be released as the new myBMP later in 2009.

RWUE3 provided technical support to 20 cotton irrigators involved in BMP L&W modules. To date there are 17 cotton irrigators certified to the cotton industry's BMP Land and Water Management module.

Key Achievements - NRM bodies

The RWUE3 staff worked closely with their respective NRM Groups to implement incentive schemes which enhance the adoption of more water use efficient practices. These regional bodies have been:

- Border Rivers - QMDC and Border Rivers-Gwydir
- Darling Downs - Condamine Alliance
- Central Queensland - CHRRUP

RWUE3 worked directly with 103 irrigators to access $1,285m in funding to implement best irrigation practices on farm.

Conclusions

The RWUE3 team have successfully provided the cotton and grain irrigators with the necessary knowledge and skills to adopt and implement irrigation best practice on farm. This has in turn led to more efficient irrigation practices reflected in increased production per ML. The use of irrigation best management practices has enabled cotton and grain irrigators demonstrate their environmental credentials – something that will be further enhanced by the release and implementation of myBMP. This will also enable improved documentation of the extent of best practices within the industry.

The RWUE3 team have continued to support the industry in achieving continued improvements in WUE. This is reflected in the 27 per cent improvement in IWUI within Queensland from 2002-03 to 2006-07 (see Table 4). Data from the demonstration sites during RWUE3 show the significant improvements being obtained as a direct result of adopting irrigation best management practices promoted by RWUE3 staff – significant improvements in both GPWUI and IWUI are reported.

Current industry performance is GPWUI = 1.13 bales/ML and IWUI = 1.58 bales/ML. Therefore the target of 15% of irrigators achieving an IWUI of 2 bales/ML remains aspirational. Achievement of a IWUI target of 2 bales/ML is only possible where irrigators have made significant investments in new irrigation infrastructure (as demonstrated by the IWUI values achieved for drip and overhead system irrigation in the RWUE3 demonstration sites, and by commercial irrigators using these systems). For surface irrigation systems a more realistic target of GPWUI = 1.39 bales/ML and IWUI = 1.5 bales/ML should be set. This appears achievable based on our current knowledge. It should also be remembered that there is significant variability in the IWUI figure driven by the seasonal conditions experienced from year to year. Other measures should also be considered – particularly those related to achieving the highest possible application efficiencies for all irrigation systems being used.

Recommendations

- Use of Participatory Action Learning Model by regional irrigation extension officers to implement practice change on farm through the benchmarking of current irrigation system performance
- Implement an ongoing, coordinated communication effort to keep current and accurate technical irrigation information (including costs: benefits and information on practices) readily available
- Continue promotion and training in the use of available benchmarking tools developed under RWUE3
- Continue evaluation of overhead irrigation systems as a priority. This requires:
  - Promotion of the need for these for existing and new CPLMs to irrigators
  - Engagement with commercial suppliers of CPLMs
  - Collaboration with the two existing engineering consultants who can provide this service.
- On going delivery of training workshops post RWUE3 will be critical to the success of the irrigation industry in implementing best practice on farm. Given the difficulty with attracting

participants in some districts we believe new technologies should be investigated as a delivery mechanism i.e. webinars

- More R&D on the agronomics of irrigated crops would aid in the extension of best management irrigation practices across industries. Information on the economics of these needs to be generated and extended also.

Photo 1 Growers and consultants listen to irrigator explain the benefits of their lateral move at the Cecil Plains Cotton Growers Tour - March 2007

Photo 2 Simon White, NCEA discusses plant sensing equipment at the RWUE3 Breakfast Farm Walk, Dalby - 13 April 2007

Photo 3 Tony Lockrey, formerly TAGS presents at Storage Management Hands-On Research Session, Australian Cotton Conference, 10 August 2006

Purpose

The purpose of this report is to review the success of the Rural Water Use Efficiency 3 Project.

The over arching targets for the RWUE3 project were:

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Photo 4 Private Consultant Garry Chesterfield displays WUE signage at furrow optimisation site - 16 January 2007

Photo 5 Chinese Government delegation with NCEA staff, consultant and Jenelle Hare, RWUE3 officer at cotton variety x irrigation demonstration - 18 February 2007

Photo 6 Trevor Harris, QPIF Research Scientist assists in evaluation of new centre pivot on Darling Downs - 28 May 2008

Background

To measure the success of RWUE3 firstly the baseline data needs to be established and defined, including target audience and Water Use Efficiency indices. It was also necessary to identify the highlights achieved in the previous two projects - Rural Water Use Efficiency Initiative (RWUEI) and Rural Water Use Efficiency 2 (RWUE2)

Target Audience

The target audience for RWUE3 was estimated using data sources from the Cotton Catchment Communities CRC (the Cotton Tales distribution lists), Department of Environment and Resource Management (DERM) and Sunwater. This data is summarised in Table 3.

The DERM figures for irrigators based on the irrigation water source cannot be added together (this is because an irrigator could use water from multiple sources). The Sunwater estimates includes all licenses that extract water – including non-irrigators. Thus for evaluation purposes it was decided to use the Cotton Tales distribution lists as the best indicator of the target audience numbers - 325 irrigators in total plus 113 consultants (it is assumed that all cotton irrigators are also grain growers as well).

Table 3 Irrigator numbers in RWUE3 target regions

Source	St George Dirranbandi	Border Rivers	Nogoa-Mackenzie	Dawson Valley	Callide Valley	Darling Downs	Total
CottonTales	62	80	78		0	105	325
DERM							
- Regulated streams		37	0	0	0	132	169
- Channel system		0	2	114	0	0	116
- Groundwater		29	0	0	114	308	451
- Water harvesting		56	66	49	2	31	204
Sunwater		94	334	151	143	103	825

Baseline Water Use Efficiency Indices Data

The Water Use Efficiency Indices used in this report are the standard ones that have been adopted by the cotton industry – the Gross Production Water Use Index (GPWUI) and the Irrigation Water Use Index (IWUI). There definition is detailed in Table 4.

Table 4 Definition of water use efficiency indices

Index	Name	Definition [a]	Units
GPWUI	Gross production water use index	$\frac{\text{Total product (bales)}}{\text{Total water applied (ML)}}$ [b] [c]	bales/ML
IWUI (Applied)	Irrigation water use index	$\frac{\text{Total product (bales)}}{\text{Irrigation water applied (ML)}}$	bales/ML

[a] These definitions were taken from Purcell and Currey (2003). Here, however, the total product is given in "bales" and all water variables are given in "ML". In the original source, they used "kg" instead of "bales" and some of the water variables were given in "mm" and others in "ML".

[b] Variables can also be given in a "per unit area" basis. For instance, Total product can be given in bales/ha, and Total water applied in ML/ha, which will result in the same units of bales/ML for the IWUI (Applied).

[C] Total water applied includes irrigation, water stored in the soil profile at sowing, and effective rainfall.

The baseline WUE data was established through research by Tennakoon and Milroy (2003) for the seasons – 1996-97, 1997-98 and 1998-99 (see Table 5).

Table 5 Average WUE indices (bales/ML) within the Australian Cotton Industry

	GPWUI	IWUI
Industry Average	0.74	1.26
Border Rivers	0.77	1.36
Central Queensland	0.81	1.59
Darling Downs	0.92	1.71

IWUI data is also obtainable using the area and volume of water use statistics from Australian Bureau of Statistics and production statistics from cotton gins (available through the Australian Cotton Grower Annual Reports).

Table 6 Baseline IWUI data for Queensland

	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08[1]
Area Irrigated (ha)	61,000	73,000	124,000	105,000	44,000	20,840
Water Used (ML)	313,770	456,802	855,009	626,198	193,757	
Production (bales)	380,738	617,306	1,147,338	895,715	298,100	176,850
Yield (bales/ha)	6.24	8.46	9.25	8.53	6.78	8.49
IWUI (bales/ML)	1.21	1.35	1.34	1.43	1.54	n/a

[1] Water use data for 2007-08 seasons not yet available

Source: ABS and Australian Cottongrower

Rural Water Use Efficiency Initiative (RWUEI)

The Rural Water Use Efficiency Initiative ran from July1999 to June 2003. The key achievements were:

- Greater than 75% awareness and participation in the program
- Cotton and grain irrigators investment of $3.6 million with a government contribution of $1.5 million
- 78% of cotton irrigators had become involved in Cotton BMP by August 2001
- A 12.8% increase in water use efficiency. An increase in GPWUI ranged from 45% to 55% and the change in IWUI ranged from – 11% to 30% shown below when compared to the baseline for WUE in the Australian Cotton Industry was determined by Tennakoon and Milroy (2003).

Table 7 Average WUE indices (bales/ML) for Queensland during RWUEI

District	GPWUI	% change	IWUI	% change
Border Rivers	1.18	55%	1.51	11%
Central Queensland	1.18	46%	1.42	-11%
Darling Downs	1.33	45%	2.22	30%

The RWUEI final report recommended a continuation of funding for the project to build on its achievements.

Rural Water Use Efficiency 2 Project

The Rural Water Use Efficiency 2 Project (July 2003 to June 2006) preceded the RWUE3 project. This project continued to build on the skills developed within RWUEI. It also leveraged off the successful incentives program in RWUEI that built interest in the adoption of improved irrigation practices.

RWUE2 succeeded in:

- Building on the extension knowledge and models established in RWUEI
- Further encouraging practices change amongst irrigators under the banner of the cotton industry's BMP program
- Establishing links with the private sector to encourage the provision of high-end water use efficiency services
- Started to draw the links between catchment management objectives and on-farm practices

The RWUE2 final report recommended further investment to establish the monitoring systems and support network, and relevant business capacity, to support the linkages between on farm investments in water use efficiency technologies, catchment management objectives and sustainable water use.

Photo 7 Grower Peter Keeley and consultant Garry Chesterfield inspect cotton grown in furrow optimised field

Photo 8 Jenelle Hare, RWUE3 officer and grower Phil Clapham inspect overhead irrigation system control panel

RWUE3 Program Overview

Stakeholders

- Department of Primary Industry and Fisheries
- Department of Natural Resource, Water and Mining
- Cotton Australia
- Cotton Catchment Communities CRC
- Irrigation Futures CRC
- National Centre of Engineering Agriculture
- Irrigation Australia
- Queensland Murray Darling Basin Inc
- Border Rivers Food and Fibre
- Condamine Alliance

RWUE3 Team

- Graham Harris, Principal Development Extension Officer, Darling Downs
- Emma Brotherton, Development Extension Officer, Border Rivers
- Jenelle Hare, Senior Technical Development Officer, Darling Downs
- Lance Pendergast, Development Extension Officer, Central Queensland
- Mark Hickman, Cotton Industry National Training Co-ordinator

Evaluation Methodology

Evaluation of the RWUE3 project was conducted using secondary analysis of project records (Milestone Reports, communication records, web statistics, workshop/project feedback were used to gather data from all activities, outputs and impacts).

Photo 9 Lateral move installation on Darling Downs

Photo 10 RWUE3 officers Jenelle Hare and Lance Pendergast discuss WaterTrack Rapid with Jim Purcell, Aquatech

Key Achievements - Communication

Background

The RWUE3 team have developed and delivered timely and topical irrigation information to a wide audience, on a national, state and regional level. The information was distributed through the following communication channels:

- CottonTales Newsletter
- The Australian Cottongrower Magazine
- The Australian Grain Magazine
- Irrigation Australia Journal
- The Australian Cotton Conference Proceedings
- “More Profit Per Drop” e-newsletter
- Cotton and Grains Irrigation Website
- Regional Trial books
- “Darling Downs Waterchat”
- The CRDC Spotlight on R&D

Additionally, the RWUE3 team, in collaboration with CRC Irrigation Futures and Irrigation Australia Limited, published an updated Storage Management Guidelines.

All Case Studies developed were published through the aforementioned communication channels.

Objective – Capacity and Practice Change

Irrigated Cotton and Grain growers and agronomic consultants in Queensland will have increased knowledge and skills about improved water management/WUE at a whole farm level

Irrigated Cotton and Grain growers and agronomic consultants in Queensland will use developed information and learning’s to assess current performance and make changes where needed in irrigation management

Target/s

- 95% (cumulative) of industry enterprises in the region have received information about improving water use efficiency.
- 12 (cumulative) Case Studies developed and promoted through industry sources.
- 70% of growers in each region have started to make changes in management practices and/or improved equipment and/or improved operations in relation to water management

WUE Information Status

CottonTales Newsletters

The RWUE3 team have delivered a range of technical irrigation articles and updates via CottonTales Newsletter to cotton irrigators in Central Queensland, Darling Downs, Border Rivers and the Lower Balonne with a total target audience of 438 irrigated cotton and grains industry recipients. Table 8 details the breakdown of the target audience in each region targeted by the RWUE3 project.

Table 8 Cotton Tales distribution list details

Region	Growers	Consultants/Agribusiness
Central Queensland	78	28
Border Rivers	80	25
Darling Downs	105	60
St George and Dirranbandi	62	
Target Audience total	325	113

The Australian Cottongrower Magazine

The RWUE3 team have published a number of technical irrigation articles, case studies and demonstration trial reports in a regular Water Matters section within the Australian Cottongrower Magazine. This magazine reaches 98% of the irrigated cotton industry with a circulation of 1800. Following is a list of contributions by RWUE3 staff:

- Hood, S. and Carrigan, E. (2006) Siphon-less Irrigation Systems: So how did they perform?, Australian Cottongrower 27(3):44-46
- Harris, G.A. (2006) Cotton and Grain Water Team Update, Australian Cottongrower 27(6):12-13
- Harris, G. (2007) Furrow evaluation improves irrigation efficiency, Australian Cottongrower 27(7):28-33
- Carrigan, E., Harris, G. and Hood, S. (2007) The challenge of a new lateral move or centre pivot, Australian Cottongrower 28(1):16-20
- Carrigan, E. (2007) District Report Macintyre Valley, Australian Cottongrower 28(1): 62-63
- Harris, G.A., Chudleigh, F. and Shaw, A. (2007) Sprinkler Irrigation: Profitable or Not?, The Australian Cottongrower 28(4): 38-43
- Hood, S. and Brotherton, E. (2007) A Review of Siphonless Irrigation, Australian Cottongrower 28(4): 44-45
- Pendergast, L. and Hare, J. (2007) Capacitance probes-to calibrate or not to calibrate?, Australian Cottongrower 28(6): 34-36
- Hare, J. and White, S. (2008) Variety and irrigation strategy: results from a Darling Downs trial. Australian Cottongrower 28(7):22-25
- Brotherton, E. (2008) Why should you evaluate your surface system? A case study in the Border Rivers. Australian Cottongrower 29(1):21-22
- Hare, J. and Harris, G.A (2008) Leaky storages – What are the options? Australian Cottongrower 29(2):34-38
- Brotherton, E, Harris, G, Smith, P, and Wigginton, D. (2008) Deep drainage myth-busters, Australian Cottongrower 29(4): 38-43
- Harris, G. (2008), 'Cotton CRC given green light for on-farm storages project', The Australian Cottongrower 29(4): 45
- Hare, J. (2008), 'Using ET to estimate water use', The Australian Cottongrower 29(6): 39-42

- Hood, S. and Hare, J. (2009) Saving irrigation water, the environment and money, Australian Cottongrower 30(2):20-24

The Australian Grain Grower Magazine

The Australian Grain Grower magazine has a circulation of 3000 in Queensland and Northern NSW. One article was produced for it by the RWUE3 team - Carrigan, E. Harris, G. and Hood, S. (2007) So, your buying a new lateral or pivot?, Australian Grain 16(6)Northern Focus 7-8.

Irrigation Australian Journal

Harris, G. (2008) Irrigation Research, Drip irrigated cotton demonstrations on the Darling Downs, Irrigation Australia Journal 24(3): 27-30

The Australian Cotton Conference Proceedings (13th and 14th)

- Hare, J. (2008), 'Assessing the impact of irrigation management on Bollgard® varieties through on-farm trialling (2006/2007 Season)' 14th Australian Cotton Conference Proceedings 2008
- Carrigan, E and Hood, S. (2006), 'Siphonless Irrigation Project' 13th Australian Cotton Conference Proceedings 2006

More Profit Per Drop e-newsletter

The RWUE3 team, working as part of the Queensland Primary Industries and Fisheries Irrigated Farming Systems team developed an e- newsletter to deliver technical irrigation articles promoting irrigation best practice, workshops and demonstration site trial results. The e-newsletter is delivered to an extensive list on average of 957 recipients including cotton and grain irrigators throughout Queensland.

Table 9 More Profit per Drop newsletter distribution

Issue	1	2	3	4	5	Average
Date	10-Jul-07	20-Nov-07	27-Mar-08	21-Jan-09	17-Apr-09	
Number e-mailed	908	740	909	1118	1110	957
Effective number received	706	682	821	836	831	775
Number opened	323	267	304	221	220	267
% opened	46%	39%	37%	26%	26%	34%

Cotton and Grain Website

The RWUE3 team have been working as part of the Cotton Catchment Communities CRC Water Team to publish all RWUE3 articles, updates and demonstration trial reports on the Cotton and Grains Irrigation Website established under the National Program for Sustainable Irrigation (NPSI) funded project: Knowledge Management in Irrigated Cotton and Grains. The use of the website has increased over time, with an average of 174 page views per day since its establishment in July 2007 (until 21 May 2009). There have been 5190 'unique visitors' to the site with 1500 having visited more then once.

- Hood, S. and Carrigan, E. (2006) Siphon-less Irrigation systems: How are they performing?, Cotton CRC Water Team

- Carrigan, E., Harris, G.A. and Hood, S. (2007), Overhead Irrigation: The challenge of a new lateral move or centre pivot: 3 case studies of performance, Cotton CRC Water Team
- Pendergast, L. and Hare, J. (2007) Irrigation scheduling: Capacitance probes – to calibrate or not to calibrate?, Cotton CRC Water Team
- Brotherton, E. (2008) Irrigation strategies: limited water & planting decisions, Cotton CRC Water Team
- Brotherton, E. (2008) Surface irrigation: why should you evaluate your surface system – a case study in the Border Rivers, Cotton CRC Water Team
- Hare, J. (2008) Using ET to Estimate Water Use, Cotton CRC Water Team
- Hare, J. (2008) Tips for irrigated wheat, Cotton CRC Water Team
- Hare, J. (2008) New irrigated grains supplement for WATERpak
- Hare, J. and Harris, G.A. (2008) On-farm Storages: Leaky storages – what are the options?, Cotton CRC Water Team
- Hare, J. and White, S. (2008) Irrigation strategies: Variety and irrigation strategy – outcomes from a Darling Downs trial, Cotton CRC Water Team
- Harris, G.A. (2008) Drip Irrigation: Darling Downs Demonstration Trials, Cotton CRC Water Team
- Montgomery, J., Carrigan, E. and Wigginton, D. (2007) Irrigation scheduling: EM surveys for probe placement, Cotton CRC Water Team
- Pendergast, L. (2008) Winter grains: irrigated chickpea in CQ – when to plant - when to water, Cotton CRC Water Team

Regional Trial Books

The RWUE3 as part of the Cotton Catchment Communities CRC Extension Team contribute regional trial reports from demonstration sites into the Regional Trial books. The RWUE3 team published nine Irrigation reports between the Border Rivers and Darling Downs Regional Trial books, distributed to 270 cotton irrigation recipients.

Border Rivers Regional Trial Book 2006/07:

- Border Rivers Cotton Irrigation benchmarking Demonstrations
- Border Rivers HydroLOGIC demonstration Trial 2004-05
- The Focus is on Water
- Mitigating Evaporation with Chemical Monolayer Technology
- Siphon-less Irrigation 2005 to 2007

Darling Downs Regional Trial Book 2007/08:

- Hare, J. (2008), ‘Using ET to measure water use’
- Hare, J and Harris, G. (2008), ‘Leaky Storages – What are the options?’
- Hare, J. (2008), ‘Assessing the impact of irrigation management on Bollgard® varieties through on-farm trialling (2006/2007 Season)’
- Hare, J and White S. (2008) ‘Improved furrow irrigation performance - Is it an Improvement?’

Downs Water Chat

A regional RWUE3 initiative providing timely and relevant irrigation information was developed in the absence of CottonTales in the 2006-07 season. Six editions of Downs Water Chat were e-mailed to 76 Darling Downs irrigators and 45 consultants and cotton industry agribusinesses. Those sent to agribusinesses reach an even greater number of their agronomists.

- Downs Water Chat No1 –"Brief synopsis of activities this season", 6 Dec 2006
- Downs Water Chat No2 – "PAM Update", 21 Dec 2006
- Downs Water Chat No3 – "Field scale variety x irrigation demonstration trial", 12 Jan 2007
- Downs Water Chat No4 - "Update on PAM trial", 22 Jan 2007
- Downs Water Chat No 5 "Surface irrigation", 30 Mar 2007
- Downs Water Chat No 6 "Do you know your water use efficiency", 10 Apr 2007

CRDC Spotlight on Cotton R&D

RWUE3 team collaborated with Rohan Boehm, CRDC Communications Officer, to document irrigation case studies. The case studies reported;

- Johannes Roellgen, "Tyunga", Brookstead – Probing for new water efficiencies, Spotlight – Winter 2007, p12
- Rob Bellert, Norwin – Numbers prove Rob's efficiency push, Spotlight – Winter 2007, p13
- Donald Baartz, Cecil Plains – Want a bigger farm? Buy it with furrow optimisation!, Spotlight – Winter 2007, p.14
- Peter Keeley, Darling Downs – Valuable learning curve for experienced irrigator, Spotlight – Winter 2007, p.15

Storage Management Guidelines

The RWUE3 team contributed to the publication of the updated Storage Management Guidelines published by the Co-operative Research Centre Irrigation Futures and Irrigation Australia Limited.

Case Studies

Details of the case studies undertaken and published during the course of RWUE3 are summarised in Table 10.

Table 10 RWUE3 Case Study details

Case Study	Details
1	**Furrow optimisation on irrigated maize** Harris, G. (2007), Furrow evaluation improves irrigation efficiency, Australian Cottongrower 27(7):28-33
2	**Overhead irrigation system checks** Carrigan, E., Harris, G. and Hood, S. (2007), The challenge of a new lateral move or centre pivot, Australian Cottongrower 28(1):16-20
3	**Siphonless irrigation system evaluations** Hood, S. and Brotherton, E. (2007) A review of siphonless irrigation, Australian Cottongrower 28(4): 44-45
4	**Economics of converting from furrow to overhead irrigation** Harris, G.A. (2008) Overhead irrigation: profitable or not? Spotlight on Cotton R&D – autumn 2008, CRDC, p18-20
5	**Economics of converting from furrow to overhead irrigation** Harris, G.A. (2008) Overhead irrigation: profitable or not? Spotlight on Cotton R&D – autumn 2008, CRDC, p18-20
6	**Drip Irrigation on Darling Downs** Harris, G.A. (2007) Drip Irrigation – Darling Downs Trial results (Cotton and Grains Irrigation Website http://www.cottonandgrains.irrigationfutures.org.au ,uploaded 31 December 2007) Harris, G.A. (2008) Drip irrigated cotton demonstrations on the Darling Downs, Irrigation Australia Journal 24(3):27-29
7	**Cotton Variety x Irrigation Strategy Demonstration** Queensland Country Life article – "Trials test efficient irrigation", 15 March 2007 J Hare and S White (2007) Variety and irrigation strategy: results from a Darling Downs trial, The Australian Cottongrower 28(7): 22-25 Hare, J. (2008) Variety and Irrigation Strategy, Cotton and Grains Irrigation Website (http://www.cottonandgrains.irrigationfutures.org.au , uploaded 2 January 2008) White, S. and Hare, J. (2008) Improved furrow irrigation performance – is it an improvement?, More Profit per Drop No.3 Newsletter, 27 March 2008
8	**Surface irrigation evaluation** Brotherton, E. (2008) Why should you evaluate your surface irrigated system – a case study in the Border Rivers 2006-07 in More Profit per Drop No.3 Newsletter, 27 March 2008 Brotherton, E. (2008) Why should you evaluate your surface system? A case study in the Border Rivers. Australian Cottongrower 29(1):21-22
9	**Amelioration of leaky storages** Hare, J. and Harris, G.A. (2008) Leaky storages – What are the options? Australian Cottongrower 29(2):34-38 Hare, J. and Harris, G.A. (2008) Leaky storages – What are the options? Australian Grain 17(7):40-42
10	Johannes Roellgen, "Tyunga", Brookstead – Probing for new water efficiencies, Spotlight – Winter 2007, p12
11	Rob Bellert, Norwin – Numbers prove Rob's efficiency push, Spotlight – Winter 2007, p13
12	Donald Baartz, Cecil Plains – Want a bigger farm? Buy it with furrow optimisation!, Spotlight – Winter 2007, p.14
13	Peter Keeley, Darling Downs – Valuable learning curve for experienced irrigator, Spotlight – Winter 2007, p.15

Results

The RWUE3 team have achieved the target of 95% of industry enterprises in the region have received information about improving water use efficiency. RWUE3 communications channels per issue of all media used can reach in the vicinity of just under 8000 cotton and grain irrigators and industry recipients.

Table 11 Number of RWUE3 communications, distribution and recipients

Media	Editions /Issues	Irrigation Articles /reports	Promotion	Grower Numbers	Consultant Numbers	Unspecified Numbers
Cotton Tales	63	30	42	263	113	
Australian Cottongrower	11	8	3			1800
Australian Graingrower	1	1	0			3000
More Profit per Drop	5	19	10			957
Website	n/a					5190
Regional Trials Book	2	9		185	85	
Regional Newsletter	6	5	1	76	45	
TOTALS	87	69	56			

The RWUE3 team have published 13 case studies - exceeding the target of 12 case studies for the project. The case studies recorded the following practice changes and the number of growers and consultants involved in Table 12:

Photo 11 Furrow irrigated maize on the Darling Downs

Table 12 Practice change captured in RWUE3 Case Studies (excluding demonstration sites)

Case Study	District	Grower Numbers	Consultant Numbers	Practice Change
Furrow Optimisation on Irrigated Maize	DD	2	1	Grower already using best practice for surface irrigation
Overhead Irrigation Checks	CQ	9		Overhead irrigation system checks have identified problems with uniformities – growers addressing these problems
Economics of converting Furrow to Overhead	DD CQ BR	3		Growers had converted existing surface irrigation to furrow irrigation and achieved significant improvements in WUE
Drip Irrigation on Darling Downs	DD	4		Subsurface and surface drip irrigation is being evaluated by irrigators in comparison with surface irrigation
Amelioration of Leaky Storages	DD	4	1	Growers have investigated options to ameliorate seepage hotspots in storages
Probing for New Water Efficiencies	DD	1	1	Grower has been benchmarking all his fields – including one irrigated by a lateral move
Numbers prove Rob's efficiency push	DD	1	0	Grower has converted furrow irrigation area to lateral move in bid to improve WUE
Want a bigger farm? Buy it with furrow optimisation!	DD	1	1	Grower has halved length of furrows following Irrimate evaluation of surface irrigation
Valuable learning curve for experienced irrigator	DD	1	1	Gower has made adjustments to furrow irrigation practices in response to Irrimate evaluation of current practices
Total		27		

Approximately 25% of 100 respondents surveyed in the external evaluation of the Knowledge Management Cotton and Grains (Phase 2) commented that information gained contributed to a change in on farm practice or heightened their awareness of water efficiency and irrigation issues , others were considering change in the future

Learnings/Future

- A coordinator is required to keep communication efforts coming and current
- A need for accurate information, results, costs and benefits as well as information on the practices

Key Achievements - Demonstration Sites

Background

The RWUE3 team established on-farm demonstration sites on a regional level for the life of the project. To demonstrate best irrigation management practice and promote the adoption of this practice on-farm through a participatory action learning model. The sites were used to promote benchmarking as best practice and collate GPWUI and IWUI benchmark data, all data was entered into the Irrimate Surface Irrigation Database (ISID) and /or Irrigation Performance and Reporting Tool (IPART) databases.

Objective

Irrigated Cotton and Grain growers and agronomic consultants in Queensland will use developed tools and information/learning's to assess current performance and make changes where needed in irrigation management

Target

- 12 (cumulative) on-farm demonstration sites established
- 75% (cumulative) of producers have been directly involved in RWUE3 activities
- 70% of growers in each region have started to make changes in management practices and/or improved equipment and/or improved operations in relation to water management
- 6 irrigator tours (cumulative) conducted
- 6 full irrigation system audits conducted

Status

Evaluation of PAM on Surface Irrigation Performance (Darling Downs)

Established in collaboration with a commercial consultant to:

- evaluate the cost: benefit of using polyacrylamide to alter infiltration characteristics (in conjunction Irrimate Furrow optimisation).
- to promote the advantage of engaging commercial consultants providing irrigation management services to irrigators.

This demonstration site involved the evaluation and application of SoilPAM on irrigated single skip cotton. The trial had a two fold objective – to increase water infiltration with applied PAM and collectively maximise WUE using SoilPAM, Irrimate™ and Sirmod technology in a water limited situation. In the past this particular red soil type has been very difficult to get moisture into at depth. Four treatments were evaluated – an optimised and non-optimised irrigation controls without PAM applied, and optimised and non-optimised irrigations with PAM applied.

Three consultants and 2 growers were directly involved in this project. 1 irrigation trial update promoted through the 'Downs Waterchat'. There were 3 irrigations conducted including a pre-plant water. The plots were harvested for yield plus quality assessment at the end of the season. Yield results did indicate an increase in yield with the addition of PAM.

Issues with the measurements and equipment failure and application caused major problems and concern in evaluating the performance of the irrigations and determining relevant industry WUE indices. This had a major impact in determining any firm conclusions on the application of PAM and subsequently any publishing of results. Results from the early Irrimate™ evaluations showed that the PAM has had a significant effect on the infiltration characteristics of the soil. Results

without PAM indicate a typical clay soil with a high initial infiltration rate of 0.69 ML/ha (69mm) and a very low continuous infiltration rate of 0.0069 ML/ha/hr (0.69mm/hr). An average of 1.08 ML/ha (108mm) infiltrated into the soil. The distribution uniformity was extremely high at 95%. The application of PAM has changed the infiltration conditions of the by soil reducing the initial infiltration rate to 0.4 ML/ha (40mm) and increasing the continuous infiltration rate to 0.0164 ML/ha/hr (1.64mm/hr) (see Figure 1). This is a significant change which has had a considerable impact on the irrigation. The irrigation resulted in an average infiltration of 1.76 ML/ha (176mm). The distribution uniformity is less than the control trial at 85%.

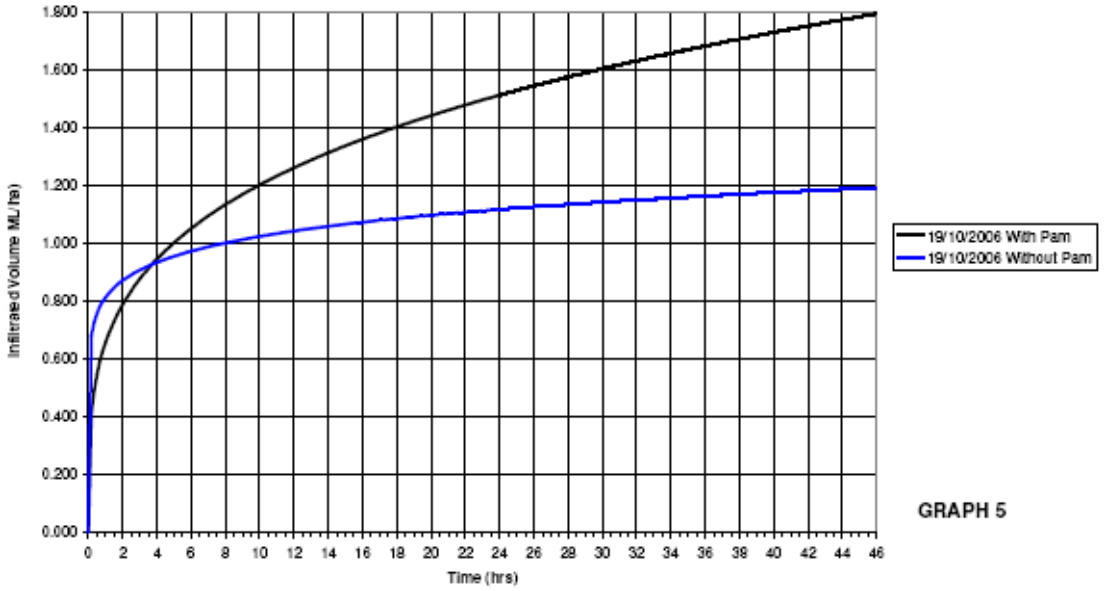


Figure 1 Cumulative infiltration curves for With and Without PAM treatments

The agribusiness consultant provided the following additional comments regarding the application of SoilPAM.

"*In a commercial sense we do expect irrigation with PAM to take longer, 2 to 3 hours to reach the end of the field, this is because there is more infiltration, but we expect the total irrigation time to be shorter as the hills will sub across more quickly and evenly. The increased infiltration and more uniformed infiltration is a result of the PAM flocculating the fine silt particles in the irrigation water and the soil surface. The fine particles are held together. This stops these fine particles slaking and filling in the soil pores, creating a sealing effect. Because these fine soil pores are held open the irrigation water flows evenly into the soil profile during the irrigation. Subbing across the rows is also increased because the soil pores are held open. PAM will help to sub-up in another way, when irrigation water is treated with PAM it becomes more viscous, the increased viscosity increases the capillary action in the hill helping to draw the moisture up to the top of the hill. This also reduces irrigation time and increases the uniformity of the irrigation. There is less tail-water run when PAM is applied to the irrigation water, this is a factor of faster subbing of the hills as the rows sub across closer to the water advance there is less time needed to run tail water to achieve a uniformed and complete irrigation. In most cases the siphons can be pulled as the water advance hits the tail drain. As the water up the furrow moves down the field the subbing will continue. As the last of the irrigation water hits the tail drain the hill will have an even and uniform moisture profile.*"

Irrigation Strategy by Cotton Variety (Darling Downs)

Site established in collaboration with Landmark, the National Centre for Engineering in Agriculture and a commercial consultant on the Darling Downs to examine the interaction of three Bollgard cotton varieties and three irrigation management strategies during 2006-07. This involved Irrimate evaluation of each irrigation event on ten treatments – around 38 irrigations during the season.

Aims included:

- Demonstration of the value of furrow optimisation
- Demonstration of a range of soil and plant based sensors to aid irrigation management
- Promotion of the advantage of engaging commercial consultants providing irrigation management services to irrigators.

This demonstration site had direct involvement of 2 growers and 2 consultants. Results published in the regional Darling Downs Cottontales and Trial Booklet, Country Life newspaper, Australian Cottongrower, and More Profit per Drop newsletter, CRCIF Cotton & Grains website as well as a paper 'Assessing the impact of irrigation management on Bollgard® varieties through on-farm trialling (2006/2007 Season)' published in the 14th ACGRA Cotton Conference Proceedings 2008. A farm walk on-site promoting trial work and activities was also conducted. Growers and consultants who attended the field day appreciated the value and dynamic relationships in the work undertaken and were anticipating the final results. There were 23 participants (of these, 4 were growers and 12 were consultants or from agribusiness).

The WUE indices from this site are presented in Table 13

Table 13 WUE Indices (bales/ML) for each treatment

Irrigation[1]	A	A	A	B	B	B	C	C	C	Skip
Variety	71B	80B	43B	71B	80B	43B	71B	80B	43B	80B
GPWUI	1.66	1.54	1.60	1.63	1.43	1.50	1.47	1.33	1.36	1.39
IWUI	1.78	1.65	1.74	1.76	1.59	1.67	1.63	1.47	1.48	1.50

[1] A = deficit of 80mm, B = deficit of 100mm, C = 120mm

The knowledge, attitudes, skills, aspiration and practice (KASAP) change achieved as a result of this demonstration are captured below.

Consultants responses

What was the most important thing you learned from this work?

It gave me a better understanding of the dynamics of irrigating and field lay out. The benefits of being able to see the affects of differing soil moisture deficits on a large scale trial, along with getting a better understanding of the crop management needed under the differing irrigation strategies.

What will you do (have you done) because of these results?

I will be implementing a change in the soil moisture deficit I use with cotton, to a smaller deficit. This means a bit more crop management over the life of the crop, but I am confident (depending on seasonal environmental factors) that this will mean a better outcome for my growers, which will aid them in long term sustainability and more efficient use of the water that they have available to them.

What was the most challenging aspect of this work?

Timing, was probably one of the challenging aspects of the work, and there were a few management issues that came to light with the three different strategies especially plant height and varietal management, this I will draw on with future work.

Comments from growers

Grower 1: After the results of the trial we learnt that our current watering practices do not need any major changes, although by lowering the deficit no water was saved it did show an increase in yield therefore improving the WUE.

Grower 2: This coming season we will run with the lower deficit and will be doubling the siphons on another farm to achieve similar flow rates and watering times.

Grower 3: There weren't any real challenges for us apart from maybe when to apply the first in-crop water. We did find however that conducting this work is very time consuming so too the parties involved we do thank you for all the early starts and late finishes achieving the results that were found.

Two years on and the growers who were directly involved in the project have finetuned their irrigation management in implementing a lower re-irrigation deficit and monitoring crop growth with the crop consultant's involvement.

In field Irrigation Evaluation (Border Rivers)

In 2006-07 six irrigations were evaluated in the Border Rivers to demonstrate best practice by quantifying water used in-field and identify simple management strategies to optimise irrigation performance to cotton growers and consultants regionally using Irrimate and SIRMOD.

The demonstration site resulted in:

- 2 growers and 1 consultant directly involved;
- one article promoting trial results and the adoption of best practice was published in the Border Rivers CottonTales, More Profit Per Drop e-newsletter and Regional Trial book, and as a case study in the Australian Cottongrower.
- Benchmarking of in-field irrigation performance (generating IWUI and GPWUI data)
- Individual irrigation evaluations included in the ISID database.

The demonstration site highlighted the importance of in-field irrigation evaluations to maximise irrigation efficiency. The GPWUI was 1.29 bales/ML. Overall the grower and consultant were aware of the benefits of maintaining a higher and less variable flow rate and aimed to reduce run times for future irrigations to reduce losses and would try to implement these practices across the farm in future. They were aware that potential savings of 1ML/ha could be saved for the season by implementing these changes, along with an opportunity to reduce running costs by minimising the amount of water to be reticulated in the tail water return system.

WaterTrack (Border Rivers)

In 2006-07 a Watertrack™ demonstration site was established to demonstrate to irrigators the importance of accurate measurement and monitoring of farm water movement and to identify losses in and between the systems to achieve greater water use efficiency. This involved collaboration with a commercial consultant to collect in-field irrigation data (using Irrimate™ and SIRMOD) to determine the whole farm water balance using WaterTrack™. The demonstration site resulted in:

- 1 grower, 1 farm manager and 1 consultant directly involved, to collect and input data to WaterTrack™
- 1 article published in the Australian Cottongrower
- in-field irrigation performance was benchmarked, generating IWUI and GPWUI
- individual irrigation evaluations included in the ISID database.

The WaterTrack™ results are presented in Figure 2. The data showed that only 38% of available water was used by the crop (2,077 ML) with storages losses of 21% (1,205 ML) and field losses of 32% (1,824 ML).

The demonstration site highlighted the importance of accurate measurement and monitoring of farm water movement. Identifying where losses are occurring provided them with an opportunity to achieve greater water use efficiency where storage evaporation and seepage accounted for a significant amount of the measured total losses. Minimal deep drainage at the field scale was measured on this farm as a result of high field application efficiencies derived from Irrimate™ evaluations. The irrigators involved realised that there was plenty of scope on their farm to improve whole farm water use efficiencies as a result of this demonstration site.

SEASONAL STORAGE AND DISTRIBUTION LOSSES

2nd September 2006 - 31st March 2007

	MacIntyre valley farm	Namoi valley farm
	ML	ML
Total Water Supplied to the Farm	**5666**	**10853**
Storage Losses		
Seepage	156	472
Evaporation	1049	988
Total Storage Losses	**1205**	**1460**
Supply Channel Losses		
Seepage	15	76
Evaporation	120	184
Total Channel Losses	**135**	**260**
Tail Drain Losses		
Seepage	4	48
Evaporation	72	135
Total Drain Losses	**76**	**183**
Total Storage and Distribution Losses	**1416**	**1903**

Figure 2 Seasonal storage and distribution losses farm

Siphon-less Irrigation sites (St George and Border Rivers)

RWUE3 in collaboration with SIS consulting and NRW continued the evaluation of siphon-less irrigation systems in comparison with conventional furrow irrigation at four separate demonstration sites. The systems evaluated were:

- bank-less channel
- bank-less head ditch
- pipes through the bank
- lateral move.

These demonstrations resulted in:

- five presentations on results to the Australian Cotton Conference, WaterTAPS, CSD Web on Wednesday, CRDC Cotton Reel; Cotton Industry Field Day Auscott Narrabri, Cotton Industry Field Day Balonne and the Big Day Out
- 3 articles published Australian Cotton Grower and the CCA Cotton Yarns.

The WUE indices for the four demonstration sites are summarised in Table 14.

Table 14 WUE Indices for siphon-less irrigation sites

	IWUI		GPWUI	
Irrigation system	**2005-06**	**2006-07**	**2005-06**	**2006-07**
Bank-less channel	0.87		0.73	
Furrow	0.86		1.08	
Bank-less head ditch	0.23		0.21	
Furrow	0.85		0.72	
Pipe through bank	1.15	0.77	0.88	0.62
Furrow	0.71	0.91	0.58	0.67
Lateral Move		1.19		1.05
Lateral Move	2.70	2.32	1.28	1.31
Furrow	1.09		0.83	

The Knowledge, attitudes, skills, aspiration and practice change implemented by the four growers participating in the project are as follows:

Grower 1 (lateral move)

- Irrigation management is the key factor to maximising each system from its ability to maximise rainfall events to distribution evenness of irrigation across any system (flood or sprinkler or bankless channel). Along with managing your system to reduce impacts of water logging, poor infiltration in soils to suit soil types and field lengths.
- Increase distribution uniformity, more timely irrigations, get water on and off and maintain head height to maximise flow rate. Adopt different farming practices accordingly to soil types to increase rain infiltration.
- Understanding the benefits of each different systems as well as implementing changes to increase WU yield, while achieving and maintaining a labour and cost benefit

Grower 2 (pipe through bank)

- Managing high flow rates and run times to get the water on and off
- Long term looking at installing more pipe through banks due to the advantage of labour saving, and now that we know we can manage it more effectively.
- Starting the siphons… limited water situation is challenging with maintaining high heads for high flow rates.

Grower 3 (bankless head ditch, lateral move)

- The WUE, flow rates & run times, still more work on bankless head ditch systems but will persevere due to labour saving advantages along with the potential shown for these system stop perform if appropriately managed
- Implementing more alternate systems on farm with a Lateral move already installed for one season along with pipe-through-banks installed for the next irrigation saving again due to labour saving and the potential of these systems to perform as an optimised irrigation practice
- Making sure everything is up to specification, maintaining levels with in field especially when cultivating, making sure head heights are maintained through out irrigations.

Grower 4 (bankless head ditch)

- Irrigation efficiency- thought we were good irrigators but the project allowed us to really investigate our irrigation efficiency and how it varies from field to field, system to system, a steep learning curve for all – using the flow meter and evaluating individual irrigations
- We now double siphons for the 1st 3 in-crop irrigations, and it is important across all systems to maintain an increased flow rate . A survey of storage to determine the volume and monitoring the volume throughout the season allows u s to have greater understanding of the water on and off, with estimates of losses and also tail water returned we now have a better handle of our WUE
- More exciting than anything with the knowledge that our irrigators now have on farm, I suppose the challenge is in implementing the best practice . Overall a great opportunity.

Storage seepage assessments (Central Queensland)

Storage seepage assessments were conducted on three storages in the Emerald Irrigation Area.

Two of the storages indicated that seepage was not a significant issue however a third storage appeared to suffer from significant seepage losses. Although the operator had known of this problem for some time the evaluation enabled a quantification of the losses and prompted a EM survey of the storage when dry. As a result specific areas of storage floor have been identified as prone to leakage and consequently a cost benefit analysis of a targeted remediation program is currently underway. This particular case study has been used to encourage participation in the Cotton Catchment Communities storage project that is currently underway and as an example for use when discussing the value of EM technology to identify problematic areas. There has been one update in CottonTales and three growers directly involved.

Sustainable Farming System Trial and Demonstration site (Central Queensland)

The RWUE3 officer used a series of capacitance soil moisture probes, complimented by weekly neutron probe readings to schedule irrigations on the Sustainable Farming Systems sequential planting cotton Trials. Regular weekly attendance of the RWUE3 officer at the on-site meetings of the multi-disciplinary team involved in these trials enabled a co-ordinated irrigation strategy to be implemented. A number of furrow optimisation evaluations were conducted and water use efficiencies, based on siphon and tail-water monitoring, were determined for inclusion into the Sustainable Farming Systems Trial reports. This project has recently concluded and results are to be included in the next CQ Cotton yearbook and as case studies published in the Australian Cottongrower magazine.

Nyang Demonstration Site (Central Queensland)

This site is being run in collaboration with Central Queensland University to evaluate the use of oxygation to enhance the performance of cotton and grain crops irrigated with sub-surface drip irrigation. Data is also being collected to develop crop coefficient for crops irrigated this way. To date cotton, sorghum and chickpeas have been grown on the site.

Meteorological and soil moisture data from this ongoing trial site have provided a valuable data base for the further development of methodology to determine crop coefficients (Kc).

The WUE indices for this site are presented in Table 15. The 2007/08 season experienced abnormally high rainfall (resulting in the Emerald floods) which negatively impacted on the success of the trial. Whilst a reasonable yield was produced the value of crop coefficients determined are limited given the extreme climatic conditions that prevailed.

Table 15 Nyang Oxygation demonstration site results

	2007/08			2008/09		
	Oxygated	Non oxygated	Average	Oxygated	Non oxygated	Average
Yield (bales/ha)	8.8	7.9	8.4	6.9	6.5	6.7
IWUI (bales/ML)	2.6	2.3	2.5	2.9	2.7	2.8
GPWUI (bales/ML)	1.1	0.9	1.0	1.3	1.2	1.2

High Yielding Irrigated Grains in Cotton Farming System Project (Darling Downs)

Five irrigated wheat demonstration sites were established under different management and irrigation regimes (surface irrigated and overhead irrigation systems) in the cotton farming system as part of the GRDC funded "High yielding irrigated grains in cotton farming systems" project. This included irrigation evaluations and monitoring plant growth stages using Zadoks scale. The outcome was to develop best management practices for irrigated wheat in the cotton farming system and determine what inputs are effective in producing high yielding grain. Three sites returned yield results and WUE indices. There were 6 growers and 2 consultants directly involved.

Table 16 IWUI for irrigated wheat in 2008 season

Site	Irrigation layout	Rotation	IWUI (t/ML)
1	Surface	Cotton/Wheat	1.85
2	Surface	Sorghum/Wheat	2.99
3	Overhead	Cotton/Wheat	3.01
4	Overhead	Cotton/Wheat	2.49

The knowledge, attitudes, skills, aspiration and practice (KASAP) change implemented as a result of the High yielding grains project are captured in the following narratives:

Grower 1

"Preparation time and timing to get operations done is critical – need to have a reasonable seedbed when coming from cotton plus good variety choice otherwise there could be establishment issues". "Need to focus on the inputs, prepare to water on, and hold the first watering, bump up sowing rate into cotton stubble".

Grower 2

"Price drives the decision to plant irrigated wheat". "Wheat as a rotation crop coming from cotton adds benefits to soil and the next crop". "Later plant requires increased sowing rate".

Grower 3

"Look at different variety choice and disease rating, could be a bit earlier for first watering, price and water availability will drive decision on what to plant, confident in producing a 5 tonne crop, water used on the wheat crop was very profitable and 50cm row spacing possibly could have been a limiting factor."

Grower 4

"Disappointing yield considering inputs, maybe consider increasing sowing rate, trash affected emergence – needed to water to optimise emergence".

The participatory action learning model employed through the demonstrations sites was 100% successful in growers measuring irrigation practices and implementing practice change on farm and should be employed in further projects to maximise WUE for cotton and grain irrigators.

Determining water use in soybeans under both surface and overhead irrigation systems (Darling Downs)

On the Darling Downs approx 10,000 ha irrigated and dryland acreage approx 2,500 ha planted to soybeans. RWUE3 collaborated with local consultants to gather local soybean WUE information.

Photo 12 Soybeans being irrigated with centre pivot

- EnviroSCAN Solo unit and ET Gage equipment installed at 2 sites in monitoring crop water use of soybeans.
- Collecting data, monitoring crop growth and development, groundcover in-crop.
- Measuring water applied to crop. Second in-crop irrigation measured.
- Developing methodology and determining correct process in using ET as another scheduling tool.
- Building and developing relationships in grains industry.

The project aims to strengthen the use of alternative methods of irrigation scheduling to improve water use efficiency and provide the Australian soybean industry with quantitative measurements of crop water use. Ultimately the project will provide growers and associated personnel with information on crop water use and demonstration of other practices e.g. ET based scheduling for irrigation events.

A farm walk involved 30 Northern NSW soybean growers on-site to review the use of EnviroSCAN technology to monitor crop water use. Both trials have been harvested but final results are still pending at the time of this report.

Consultant mentoring program (Darling Downs)

RWUE3 on the Darling Downs have been collaborating with Sarah Hood as the project consultant in a Condamine Alliance funded project "Delivering increased adoption of best management practices in water use efficiency to the cotton industry in the Condamine catchment". The project has successfully integrated into the Cotton CRC water team extension activities on the Downs, Cotton Australia BMP program and the wider NPSI knowledge management project aiming to increase the capacity of agronomists to deliver irrigation services across the entire cotton industry.

An example of the benefit of this program was collaboration instigated with DERM staff to investigate the soil properties at a site where Irrimate evaluations occurred. This was prompted by the results obtained from this evaluation. This resulted in collaborative links developed with the consultant, grower, DERM researchers and RWUE3, leading to better understanding of the soils being irrigated.

Ten consultants were engaged in the project. Collectively they have 98 clients outside of the 15 growers directly involved in the project. This indicates the post project potential if the consultants incorporate their new skills in irrigation services offered to clients. The majority of consultants chose field irrigation efficiency (both furrow and overhead) as their research priority. Some also opted to include whole farm benchmarking. Training delivered:

- one consultant participated in WaterTrack Rapid^{TM} training
- five in the Surface Evaluation Irrigation Training workshop.

Consultant 1

Currently provide an irrigation scheduling service using EnviroSCANs and two Diviner 2000's

As a result of the project:

- IrrimateTM Furrow Irrigation evaluations on multiple paddocks of one of his clients
- Attended the Surface Irrigation Performance Evaluation module of the Cotton and Grains Workshop Series.
- Attended the Centre Pivot and Lateral Move module
- Conducted an overhead irrigation evaluation.

Consultant narrative:

The best thing that about the project was actually doing stuff, getting a result and learning a new skill and learning something that will be beneficial in the future. I really enjoyed the overhead evaluation because it gave me a better understanding of how well those machines need to be set up.

I was most pleased with the exposure that we had to Irrimate™ and I now have better appreciation for where this service sits with my clients and my business. For example I think that my clients around Dalby and Macalister who are getting the water on and off in 8 to 10 hours are probably not doing a bad job. I have more confidence in making that statement. I think that I would suggest that if this is not the case then I would talk to growers that I about doing some evaluations. I think that I would be able to generate an economic argument for these clients based on the experience I have through this project.

Consultant 2

Currently provides and extensive Irrigation scheduling service to 23 clients and an Irrimate Evaluation service. By providing WUE advice to their clients they have already seen gains of 20% plus in water saving per irrigation event.

As a results of the project:

- Irrimate™ Furrow Irrigation evaluations on multiple paddocks for several clients.
- Attended the NPSI Lateral Move and Centre Pivot training course
- a storage management activity which included surveying to get a rating curves, the uts of electronic gauge boards to improve irrigation budgeting skills and exposure to the use of EM surveys to investigate storage losses.

Consultant narrative:

The project provided a catalyst for some growers who have not been interested in WUE the past. The quality of the reporting from Aquatech was disappointing. The reporting service from level 1 Irrimate consultants needs to be more interactive with the grower. For example sometimes growers will not consider a 3 inch siphon and when a recommendation comes back using 3 inch siphon they become disenfranchised from the process.

The economist was so valuable so it would be really good if we could keep that going particularly as different answers are required. A few of the growers this year were interested in the economic comparison of:

- Going from less than optimum furrow irrigation management to optimized furrow irrigation management and then overhead.
- The opportunity cost of removing channels based on seepage losses

Consultant 3

Provides agronomic advice and services to approximately 22 farmers across the Darling Downs.

As a result of the project:

- Irrimate Furrow Irrigation evaluations on the paddocks of two of his clients.
- Attended the Surface Irrigation Performance Evaluation module of the Cotton and Grains Workshop Series.
- Attended the Centre Pivot and Lateral Move Module
- Employed an agronomist to evolve into a precision agronomist where water advice including Irrimate™ and storage assessment and remediation will be a component of this in the future but the basics will come first.

Consultant narrative:

The three main things holding me back at the moment is farmer's attitudes, cost to provide the service and back up support. The project has highlighted for me, as I expected, that Irrimate™ is not the first step and there is other more important primary issues that need to be addressed before this fine tuning can occur. I would be suggesting to growers that they spend money on the big returns on investment such as leaking storages and fully understanding the limitations and opportunities of their soil resources. I feel that Irrimate is too expensive to use in situations where it reinforces what we the grower and consultant already think we know. It is more useful when there is real gains to be made and this comes with understanding where the opportunities lie.

Consultant 4

Provides agronomic advice including scheduling irrigations with crop monitoring and neutron probes for both furrow and overhead irrigated crops to 20 clients in for a range of crops including cotton, sorghum, corn and legumes.

As a result of the project

- IrrimateTM Furrow Irrigation evaluations on the paddocks of two of his clients.
- Attended the Surface Irrigation Performance Evaluation module of the Cotton and Grains Workshop Series.
- Attended an overhead training day on farm

Consultant narrative:

My confidence has improved in both my current approach to irrigation scheduling and budgeting and my confidence in understanding when and how to utilize emerging technologies. I currently talk irrigation a lot to the growers because it is one of their most limiting factors. Doing this work has actually made me think that may be I have been on the right track in terms of scheduling and budget/irrigation scheduling. The only new technology that we looked at was Irrimate™ and I had had no exposure to Irrimate™ before now. I feel that this exposure has been valuable. I found it valuable enough that I would like to deliver this service in the future. I felt the Irrimate™ support from the level 1 consultant was disappointing. *The participatory action approach to the project was fantastic*

Consultant 5

The agronomy team ranges between 4 to 6 agronomists providing agronomic advice to 15 to 20 growers including irrigation scheduling service and other agronomic services to a wider client base of another 30 clients across the central Darling Downs.

As a result of the project:

- Attended the Surface Irrigation Performance Evaluation
- Attended the Centre Pivot and Lateral Move modules
- Investigated offering storage management advice in conjunction with an irrigation engineering company.

Consultant narrative:

The project has allowed me to increase my knowledge further particularly in relation to storage management and remediation. The overhead course was good because we had been managing these machines without any formal training and it helped immensely to marry the research with our on ground observations. Just to have the support materials is has been invaluable as a reference.

Results

Table 15 summarises the participation, activities and impacts of the demonstration sites within the RUWE3 project. It can be seen that the RWUE3 project established more than the expected 12

Table 17 Outputs from RWUE3 demonstration sites

Demonstration	District	Seasons	Grower Numbers	Consultant Numbers	Number of Sites	Number of Evaluations	Extension Activities	Practice Change
PAM	Darling Downs	2006-07	2	3	1	4		Inconclusive trial results
Irrigation Strategy by Variety	Darling Downs	2006-07	2	4	1	38	7 Articles 1 Farm walk (23 participants)	Change in soil moisture deficit for next irrigation and timing of first irrigation
Irrigation Evaluation	Border Rivers	2006-07	2	1	1	6	4 articles	Maintain a higher and less variable flow rate and reduce run times
WaterTrack™	Border Rivers	2006-07	2	1	2	6	1 article	Opportunity to reduce losses identified
Siphonless Irrigation	Border Rivers and St George	2005-06 and 2006-07	8	4	4	?	3 articles 3 presentations 2 field days	Fine tune irrigation management due to evaluations and system change.
Storage losses	Central Queensland	2007-08	3		3	3	1 article	Cost benefit analysis of remediation
Sustainable Farming System Trial	Central Queensland	2007-08 2008-09	20	2	1	?	1 field day	Irrigation scheduling and evaluation to optimise WUE
Oxygation in Drip	Central Queensland	2007-08 and 2008-09	1	1	1		1 article	Methodology to determine Kc
High Yielding irrigated grains	Darling Downs	2008	6	3	5			Planting rate, agronomic issues
Determining water use in soybeans	Darling Downs	2009	30 indirectly		2	2	1 farmwalk (30 growers)	Employ irrigation scheduling methods to improve WUE and provide quantitative measures of Soybean WU.

Consultants Mentoring – Condamine Alliance	Darling Downs	2007-08 and 2008-09	15 directly. 98 indirectly	10	15	18	9 consultants attended one or more workshops Case Studies pending	Increased capacity of consultants to deliver: • Overhead System evaluation • Irrimate TM Evaluations • Storage survey • Precision Agronomist Employed • Investigation of storage management
Total			189	29	36	77	17 articles 5 farm tours/field days/farm walks 3 presentations	

demonstration sites during the course of the project. These were very valuable in demonstrating the latest strategies to improve on-farm WUE and were critical in developing the knowledge and skills of consultants servicing the industry.

Learnings/Future

The RWUE3 team have demonstrated that Participatory Action Learning Model employed in the demonstration results is a key tool to implementing practice change on farm - it is difficult to maintain the model without active irrigation extension officers located regionally.

The demonstration sites are labour intensive and in some cases to the detriment of extending the findings, i.e. reducing the capacity of the extension staff to deliver timely results and learnings.

To leverage on the success of the demonstration sites with the growers and consultants directly involved, further effort is needed to target a wider audience through farm tours and communication.

Photo 13 RWUE3 officer Emma Brotherton explains deep drainage research site to Dr Jose Payero, University of Nebraska

Photo 14 RWUE3 officer Jenelle Hare downloads EnviroSCAN data from cotton variety x irrigation demonstration at Dalby

Photo 15 RWUE3 officer Lance Pendergast inspects oxygation equipment at drip irrigation demonstration

Key Achievements - Benchmarking

Background

Benchmarking Irrigation performance has always been a challenge. As part of the RWUE3 project the team in, collaboration with the Cotton Catchments Communities CRC, NCEA and the Knowledge Management Phase 2 project, aimed to standardise the irrigation indices in use within the cotton industry. This was achieved through:

- the delivery of training workshops
- access to benchmarking tools
- promotion of benchmarking as a best practice to be adopted on farm.

Objective

Irrigated Cotton and Grain growers in Queensland and agronomic consultants will use developed tools and information/learning's to standardise Water Use Indices for benchmarking.

Target

65% of irrigators benchmarking their irrigation activities and adopting water use best practice

Status

1. Graham Harris and Dr Jose Payero reviewed water use efficiency benchmarks for cotton both nationally and internationally – funded through the Cotton Catchment Communities CRC funded *Project 5.09.04 Benchmarking Water Management in the Australian Cotton Industry*. As a result of this review a draft report "Review of Water Use Efficiency Benchmarks in the Australian Cotton Industry" was prepared. This project also led to the development of the following benchmark tools:

- WUE Benchmarking Tool - a web-based tool enabling irrigators and their consultants estimate the standard WUE Indices that have been established for the cotton and grains industries at the farm scale. This tool is available for use by the industry as part of the Cotton BMP process. Use of the tool is demonstrated in the Irrigation Benchmarking and Water Budgeting workshop delivered as part of the Cotton and Grains Workshop series. By February 2009 there had been 35 users on 97 occasions but 3 users had registered to provide their data for industry use.
- Irrimate Surface Irrigation Database (ISID) – this was developed by the NCEA through the Cotton CRC funded *Project 5.09.04 Benchmarking Water Management in the Australian Cotton Industry.* This enables the collation of existing results from the Irrimate surface irrigation evaluations in the industry and their interrogation. The intention is that all future Irrimate evaluations can be added to this database so that an on-going record of surface irrigation evaluations can be captured.

2. The RWUE3 team assisted the Cotton Catchment and Communities CRC Water Team to benchmark 36 cotton and grain irrigation farms from Hillston to Emerald using WaterTrack Rapid™ – a commercial benchmarking tool developed by AquaTech Consulting, Narrabri.
3. The RWUE3 team have delivered seven Irrigation Benchmarking and Water Budgeting training workshops to 59 participants. This workshop was with assistance of the RWUE3 team in the NPSI funded Knowledge Management in Irrigated Cotton and Grains (Phase 2) project.
4. RWUE3 team have promoted benchmarking on farm as part of all demonstration sites using commercial tools, WaterTrack™, irrigation evaluations and overhead system audit data.

Surface irrigation performance data has been entered into ISID and overhead system audit data has been entered into the Irrigation Performance and Reporting Tool (IPART) database.

5. RWUE3 team provided technical support to the BMP Land and Water Management module which requires irrigators to benchmark the performance of their on-farm water use.

Benchmarking Water Use in the Australian Cotton Industry

This project resulted in:

- preparation of the report – Payero, J.O and Harris, G.A 2008 Review of Water Use Efficiency Benchmarks in the Australian Cotton Industry, DPI&F
- development of a WUE Benchmarking Tool
- development of the Irrimate Surface Irrigation Database (ISID)
- benchmarking cotton and grain irrigators in each region using WaterTrack Rapid™ by the Cotton CRC Water Team

The ISID database currently contains 100 surface irrigation evaluations for Queensland – this includes many conducted during each phase of Rural Water Use Efficiency. The results are summarised in the accompanying figures (Figures 3, 4 and 5).

Figure 3 Furrow irrigation application efficiency statistics for Queensland

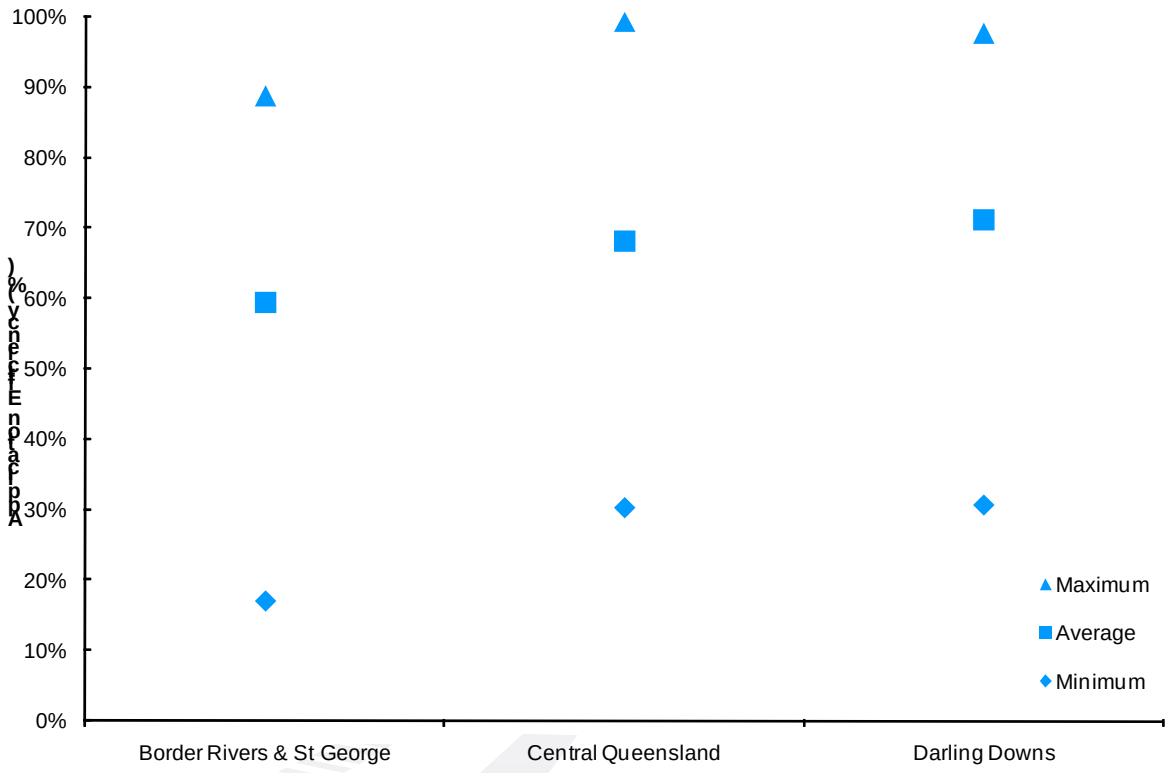


Figure 4 Furrow requirement efficiency statistics for Queensland

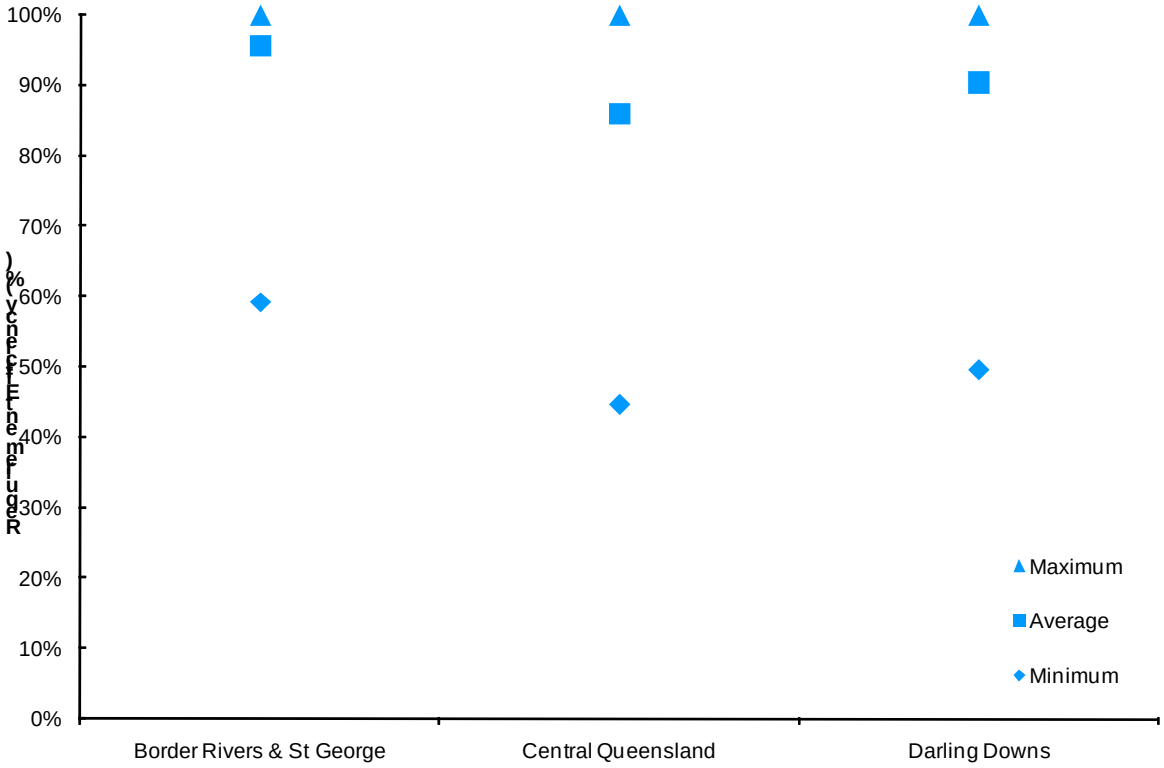
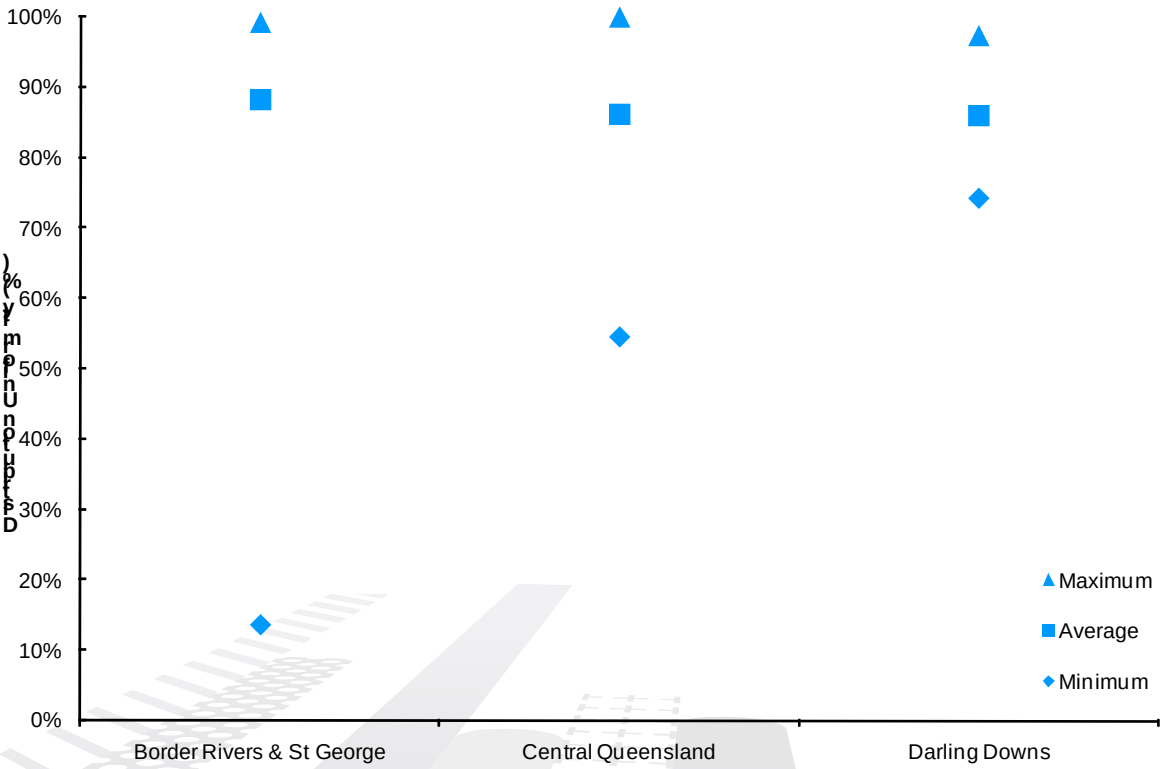


Figure 5 Furrow distribution uniformity statistics for Queensland



The results show a significant spread in the performance of furrow irrigation across Queensland. Using SIRMOD to optimise furrow irrigation suggests that significant improvements can be made in

improving the performance of furrow irrigation. Table 18 compares the measured furrow irrigation statistics for 100 furrow irrigation evaluations against the optimised furrow irrigation evaluations.

Table 18 Comparison of 100 measured and optimised furrow irrigation events for Queensland

Averages	Measured	Optimised
Number of Evaluations	100	100
Depth Applied (mm)	121	98
Infiltration (mm)	94	91
Deep Drainage (mm)	22	15
Runoff (mm)	26	7
Application Efficiency (%)	65%	81%
Requirement Efficiency (%)	92%	96%
Distribution Uniformity (%)	87%	83%

The data suggests that significant improvement in application efficiency can be obtained by optimising furrow irrigation, primarily through flow rate and cut-off time changes – for this data the improvement is an average increase in application efficiency from 65% to 81%.

WaterTrack Rapid™

The 2006-07 WaterTrack ™ results recorded the average GPWUI for the 36 farms surveyed to be 1.13 bales/ML, with a range of 0.82 to 1.71 bales/ML. There was an average yield of 11.12 bales/ha. 70% of the water reaching the farm is converted to product, indicating total losses to be in the vicinity of 30% at the whole farm scale. By comparison the top 12 farms had an average yield of 12.7 bales/ha and the losses were reduced to 20% across the farm. Based on these results a realistic GPWUI Target could be set at 1.39 bales/ML – currently the top performers are achieving a GPWUI of 1.26 bales/ML.

Irrigators remain very cautious of benchmarking processes as demonstrated by the sort of questions asked of, and statements made to, the survey team:

- ‘Where data was going’?
- ‘Why was it being collected’
- ‘this data could be dangerous’.

Figure 6 WaterTrack Rapid yield, gross water inflow and losses - 2006-07

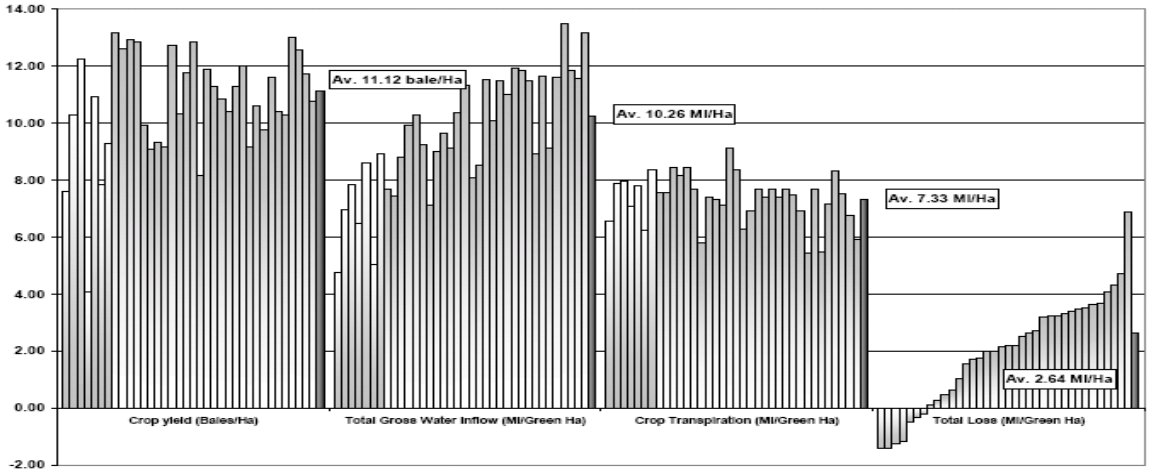


Figure 7 WaterTrack Rapid WUE benchmarks - 2006-07

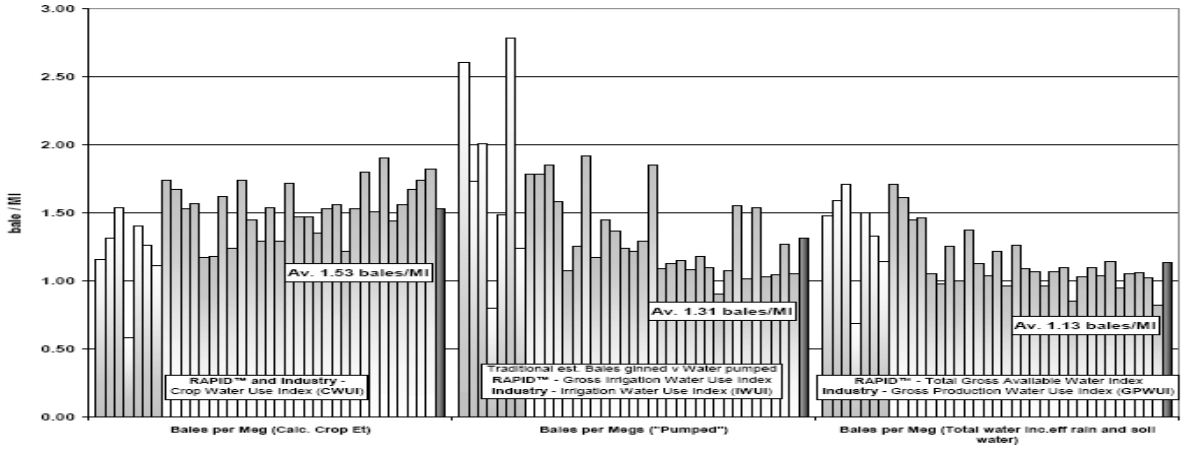


Figure 8 Performance of top 10 farms - 2006-07

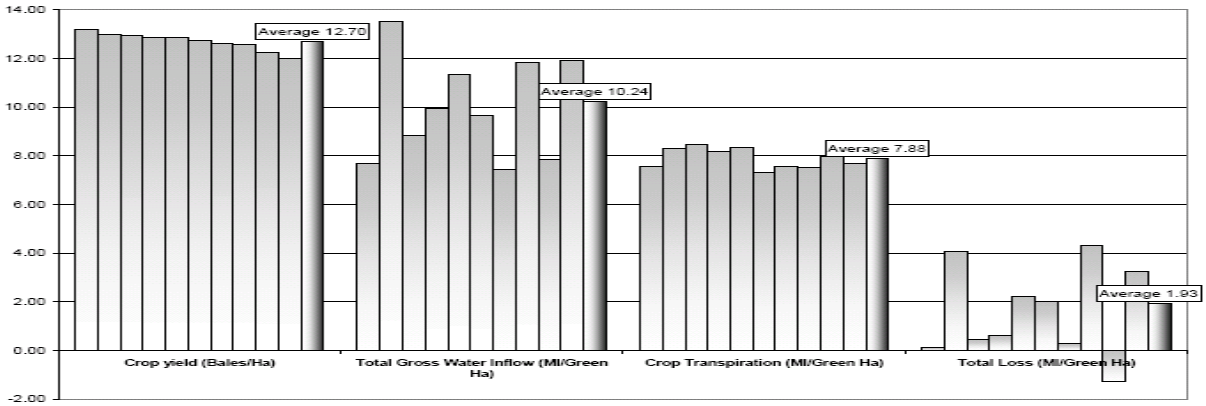
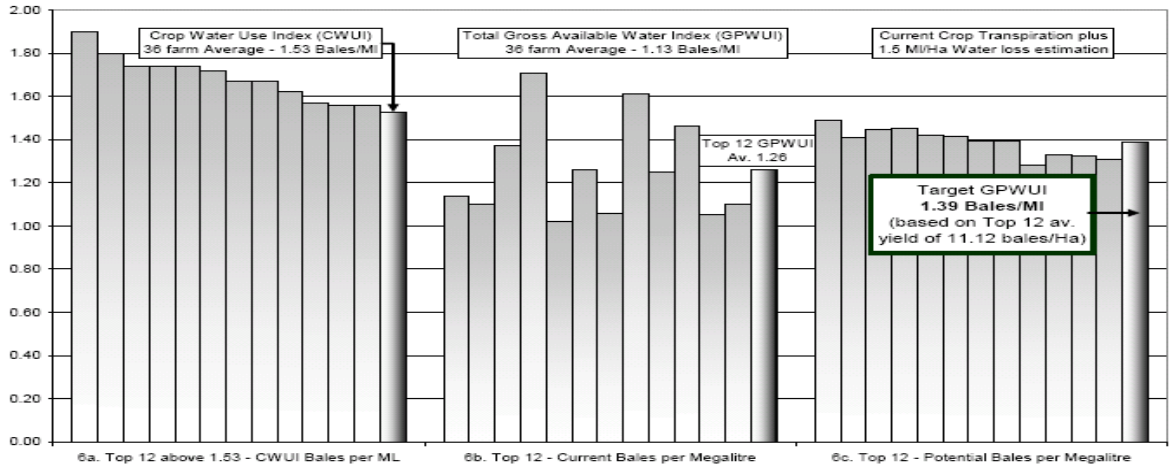


Figure 9 Estimated potential GPWUI of top 12 performing farms, 2006-07



Benchmarking Workshops

Evaluation of the 59 participants of the four Irrigation Benchmarking and Water Budgeting provided the following data:

- A high proportion of participants had increased their understanding from a good to an excellent level (e.g. 50, 80, 90 and 90%)
- At one workshop 75% of participants indicated they would use benchmarking in their farming operation, and 25% would use parts of the process in future operations
- At another workshop 80% of participants indicated they would use the new knowledge in their everyday management.
- All participants indicated they would use benchmarking now on their farms or with their clients.

Photo 16 David Wigginton, NSW DPI presents Cotton and Grains Benchmarking workshop to Theodore Irrigators

Demonstration Sites

The benchmarks obtained from the demonstration sites are reported in Tables 19 and 20.

Table 19 GPWUI in cotton (bales/ML) and wheat (t/ML) in RWUE3 demonstration sites

Demonstration/Treatment	2005-06	2006-07	2007-08	2008-09
Variety x Irrigation Trial				
Irr A 71B		1.66		
Irr A 80B		1.54		
Irr A 43B		1.60		
Irr B 71B		1.63		
Irr B 80B		1.43		
Irr B 43B		1.50		
Irr C 71B		1.47		
Irr C 80B		1.33		
Irr C 43B		1.36		
Skip 80B		1.39		
Siphonless Irrigation Sites				
Bank less Channel	0.73			
Furrow	1.08			
Bank less Head Ditch	0.21			
Furrow	0.72			
Pipe Through Bank	0.88	0.62		
Furrow	0.58	0.67		
Lateral Move		1.05		
Lateral Move	1.28	1.31		
Furrow	0.83			
Drip Irrigation Trial				
Oxygated			1.10	1.30
Non Oxygated			0.90	1.20

Table 20 IWUI in cotton (bales/ML) and wheat (t/ML) in RWUE3 demonstration sites

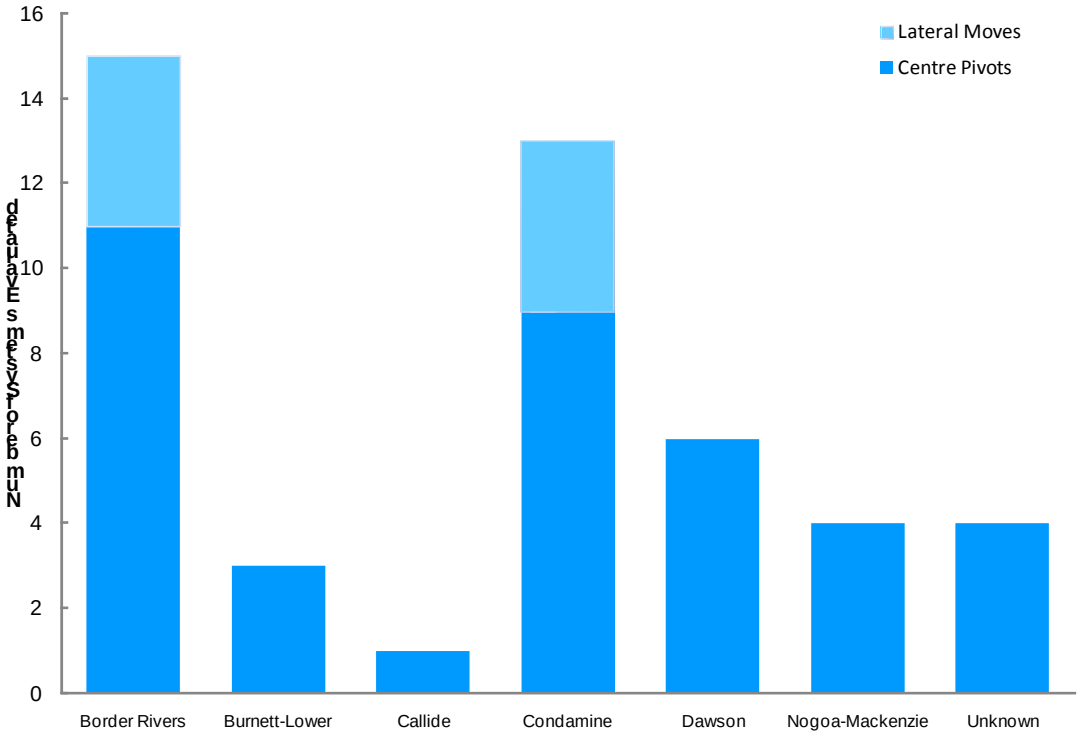
Demonstration/Treatment	2005-06	2006-07	2007-08	2008-09
Variety x Irrigation Trial				
Irr A 71B		1.78		
Irr A 80B		1.65		
Irr A 43B		1.74		
Irr B 71B		1.76		
Irr B 80B		1.59		
Irr B 43B		1.67		
Irr C 71B		1.63		
Irr C 80B		1.47		
Irr C 43B		1.48		
Skip 80B		1.5		
Furrow Irrigation (Border Rivers)				
Furrow		1.29		
Siphonless Irrigation Sites				
Bank less Channel				
Furrow				
Bank less Head Ditch				
Furrow				
Pipe Through Bank				
Furrow				
Lateral Move				
Lateral Move				
Furrow				
Drip Irrigation Trial				
Oxygated			2.6	2.9
Non Oxygated			2.3	2.7
High Yielding Irrigated Grains				
Cotton/wheat Rotation				1.85
Sorghum/wheat Rotation				2.99
Cotton/Wheat Rotation				3.01

Overhead Irrigation System Checks

To date there have been 46 overhead irrigation system checks performed through RWUE. The results of these have been entered into IPART. Further system checks are planned before the end of RWUE3.

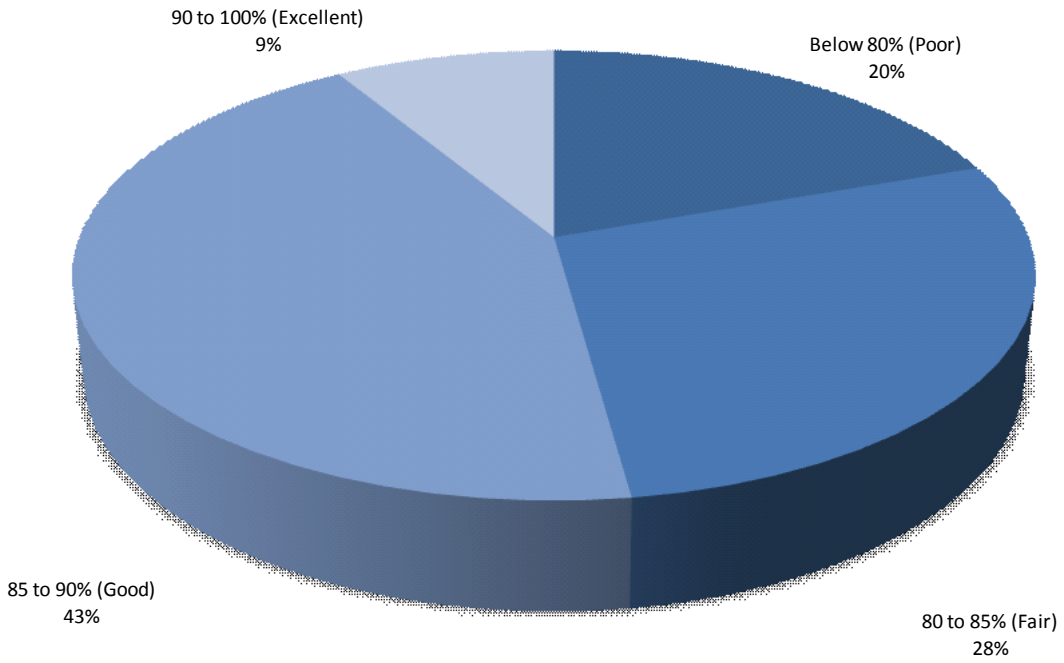
The number of overhead systems evaluations and their location is summarised in Figure 10.

Figure 10 Overhead system evaluations conducted in RWUE



The results of the overhead system evaluations conducted are summarised in Figure 11. The data indicate that only 9% of machines tested demonstrated excellent co-efficient of uniformity figures, and that 48% had poor to fair co-efficient of uniformities. These figures demonstrate the need for further extension effort to train irrigators in the importance of having overhead system evaluations conducted on existing machines and included as part of the commissioning of new machines. As a result the RWUE3 team are currently developing an overhead system evaluation awareness training workshop for the industry.

Figure 11 Coefficient of uniformity for overhead irrigation system checks conducted



BMP Land and Water Management module

RWUE3 have provided the technical support for benchmarking as part of four Land and Water Management Workshops to 20 participants. Currently 17 growers are certified to the BMP Land and Water Management module. The team have been working closely with Cotton Australia in the development of the next phase of the cotton best management practices process – myBMP.

Learning's and Future

The review of WUE benchmarks in the Australian Cotton Industry identified the inconsistencies of past benchmarking data collected and highlighted the value of the benchmarking tools developed in collaboration with RWUE3. Firstly in standardising the water use indices reported, and secondly, promoting a number of tools available to irrigators to benchmark their water use on-farm.

The Watertrack Rapid™ survey demonstrated that WUE data could be collected in a short amount of time to provide a snapshot of the industry's performance.

Evaluation of the Irrigation Benchmarking and Water Budgeting workshop indicated that training will be the best tool to provide growers with the confidence to benchmark water use on farm.

IPART and ISID benchmarking tools highlight the value of benchmarking irrigation system performance and demonstrated the need for further training and awareness of both overhead system evaluation and furrow irrigation evaluation to improve irrigation performance of individual systems.

Key Achievements - Training/Workshops

Background

The RWUE3 team were integral in the development and delivery of the Irrigation Training Workshops developed in the NPSI funded Knowledge Management in Irrigated Cotton and Grains (Phase 2) project. The workshops directly support issues that may be identified through the BMP Land and Water Module. The RWUE3 provided technical support to the Cooperative Research Centre for Irrigation Futures in the delivery of the Pivots and Lateral Move National Training Course to growers, managers and consultants. The RWUE3 team developed and delivered extension training activities to cotton and grain growers and consultants on a regional level and on a national level as part of the Cotton Catchments Communities CRC.

Objective

Irrigated Cotton and Grain growers in Queensland and agronomic consultants will use developed information/learning's to assess current performance and make changes where needed in irrigation management

Irrigated Cotton and Grain growers in Queensland and agronomic consultants will have increased knowledge and skills about improved water management/WUE at a whole farm level

Target

- 35 (cumulative) FMS workshops provided that provide advice on irrigation / water use best practice
- 50% of consultants and 40% of irrigators participating in formal WUE training activities
- 65% of growers in each region have started to make changes in management practices and/or improved equipment and/or improved operations in relation to water management
- 65% of irrigators benchmarking their irrigation activities and adopting water use best practice

Status

Cotton and Grains Irrigation Workshops

The RWUE3 team have delivered workshops across Queensland and provided technical support to delivery in NSW of the Cotton and Grains Irrigation Training Workshops developed under the NPSI funded Knowledge Management in Irrigated Cotton and Grains (Phase 2) project. Emma Brotherton authored Scheduling I and Scheduling II and Graham Harris authored the Irrigation Benchmarking and Water Budgeting. The irrigation training workshops developed and delivered focus on providing high level skills for growers, farm managers and consultants, with an emphasis on practical material that can be taken away and applied in the field. The workshops are mapped to national training competencies, so they can contribute towards obtaining a nationally recognised qualification. The workshops developed were:

1. Irrigation Benchmarking & Water Budgeting
2. Scheduling I
3. Scheduling II
4. Storage and Distribution Systems
5. Pumps
6. Surface Irrigation Performance Evaluation
7. Flow Metering

Table 21 Details of the Cotton and Grains Irrigation Training workshops delivered in Queensland

Workshop	Dates	Valley	Growers	Consultants	Others	Total
Benchmarking	19–May 07	BR	10		1	11
	9-May-07	CQ	6	1	2	9
	10-May-07	CQ		2	1	3
	19-Jul-07	BR		9	2	11
	20 Jull 07	BR		1		1
	13-Aug-07	BR	10	2	0	12
	22-Aug-07	DD	9	3		12
Scheduling I	25-Jul-07	CQ	5	1	1	7
	26-Jul-07	CQ	2		1	3
	14-Feb-08	BR	4	1		5
Surface Irrigation Performance Evaluation	17-Apr-08	DD		4	1	5
Pumps	14-Mar-08	BR	9	1		10
	26-Nov-2008	BR	4	3		7
Total		11	52	23	7	95

Centre Pivots and Lateral Moves National Training Course

The RWUE3 team provided technical support to Cooperative Research Centre for Irrigation Futures in the delivery of the Pivots and Lateral Move National Training Course to growers, managers and consultants who are considering purchasing or have purchased a centre pivot or lateral move irrigation system. The training focus was to provide knowledge on design, installation and management of systems, skills in calculating capacity and scheduling irrigation and more effective management of water and more efficient crop production. Details of the workshops conducted with the RWUE3 team in Queensland are summarised in Table 22.

Table 22 Queensland Centre Pivots and Lateral Moves National Training courses conducted with the RWUE3 team

Dates	Valley	Growers	Consultants	Others	Total
May 2009	CQ	19	1	2	22
May 2009	CQ				
19-Sept-08	BR	11	3	4	17
21-Nov-07	DD	12	5	5	22
Total	4	42	9	11	61

Other training Activities

The RWUE3 team developed and delivered extension training activities to cotton and grain growers and consultants on a regional and national level as part of the Cotton Catchments CRC. These activities were tailored by the RWUE3 team to meet specific extension needs identified by

grower and consultant groups, NRM bodies and Cotton Australia BMP. Details of these are summarised in Table 23.

Table 23 RWUE3 Training Activities

Workshop	Dates	Valley	Growers	Consultants	Others	Total
Macintyre Valley Field Day	Mar 08	BR				110
Cotton Australia GSM's – Q&A session	Nov 07	All			5	5
Lateral Move Evaluation Field Day	Nov 07	BR	20			
Pre-irrigation Training	Sep 07		1		5	6
Healthy Soil Pit Field Day	Aug -07	BR	13	4	6	23
Cotton BMP	14-Jul-06	DD		4		4
	1-Aug-06	CQ				
Cotton BMP Land & Water Workshop	6-Jul-07	BR	10			10
Whole farm water balance	10-Aug-06	All				
Centre Pivot Field Day	15-Aug-06	DD	15			15
Lateral Move Field Day	16-Aug-06	DD	20			20
Storage Compaction Field Day	18-Aug-06	DD				40
Drip Tape Field Day	29-Aug-06	DD	7			7
Investigating Limited Water Scenarios	24-Dec-06	BR				18
Storage management	10-Aug-06	All				26
TOTAL		11	42	4		46

Results

Table 24 summarises the details of the training activities delivered in the RWUE3 project.

Table 24 RWUE3 Training Activities statistics

Workshop	Total Number Workshops	Growers	Consultants	Others	Total Participants
Cotton and Grains Irrigation Training Workshops	11	52	23	7	95
Centre Pivot Lateral Move Training	4	42	9	11	61
RWUE3 Training	12	11	42	4	46
TOTAL	27	95	74	22	202

Cotton and Grains Irrigation Workshops

At each workshop evaluations were conducted to ascertain any changes in knowledge, attitudes, skills, aspiration and likely practice change by participants as a result of the workshop. The results of these are summarised below.

Surface Irrigation Performance Evaluation workshop

100% of participants at one workshop indicated they had an increased understanding of surface irrigation performance as a result of the workshop and also increased their attitude about the importance of this practice. At another workshop 75% of participants moved from a medium to high understanding of surface irrigation.

All participants that had not already conducted a performance evaluation indicated that they were now "likely" to do so, and would be further encouraged if funding was available.

Narrative recorded from consultant *"One of the best courses I have attended. Involvement in Irrimate evaluations and the theory aspect has pulled it all together for me".*

Benchmarking and Water Budgeting workshop

All participants increased there understanding of benchmarking ranging from a good understanding to an excellent understanding and could see a place for benchmarking on their farms as a result of the workshop

At one workshop 75 % of participants indicated they would use benchmarking in their farming operations, the remaining 25 % indicated they would use parts of the process. 80% of participants at one workshop indicated they would use their new knowledge in their everyday management of their farm.

Scheduling 1 workshop

All participants indicated an increased understanding of scheduling as a result of the workshop. Feedback captured at the workshops included – "*I have done other courses like this and we have saved a lot of water as a consequence*, *its good to have a refresher, gave me more techniques for calculating soil water use, helped me to understand how my agronomist works out my irrigation schedule"*.

60% of participants at one workshop indicated they would use some parts of the scheduling in their everyday management and 20% would use the process often. At another workshop 75% of participants indicated they would use parts of the scheduling process in future management

Pumps workshop

80% of participants indicated they had an improved understanding of pump curves and went home to compare their pump efficiency to the one used as an example in the course.

CRC IF Centre Pivot & Lateral Move Training

The CRC IF Centre Pivot & Lateral Move Training recorded the following new knowledge, attitudes, skills and aspirations.

The participants indicated an increased awareness and understanding of the importance of post installation system checks. As a result of the workshop a grower requested an in –field systems audit to be conducted on his farm to determine the machines performance and train growers.

Comments captured from the workshops:

- *"look at a lower deficit in future waterings"*
- *"all new"*
- *"Managed to pick up information even though I already had a reasonable understanding"*
- *"They are a precision tool and need to be used this way"*

- *"I increased my knowledge from a rating of 2 to 6 - but I need to learn more"*

As a direct result of their attendance at the workshops held in the Central Queensland a number of growers have been in dialogue with their suppliers to address issues identified with their machines. Whilst ambivalent before the workshops the majority of participants have since expressed their intention to include an audit in the purchase process of any future systems and for audits to be conducted on their existing systems.

RWUE3 Training Activities, Field Days and Workshops

Q&A Training session with Cotton Australia to up-skill GSM's in relevant L&W module Irrigation topics

Recorded New Knowledge, Attitudes, Skills and Aspirations and Practice Change: "*We should have done this a long time ago, We will have to go back to more recent PCA's and change ranks according to what we now know is Best practice".*

CRC IF Centre Pivot & Lateral Move In field Evaluation training

Recorded new knowledge, attitudes, skills, aspirations and practice change included:

- all participants gained an increased understanding of measurement and monitoring of water use on overhead irrigators, resulting in greater access of irrigation services.
- the owner of the lateral move has instructed the supplier to rectify setup and infrastructure problems as identified by RWUE3 cotton water team staff
- an irrigation consultant from Tamworth was engaged by another 3 growers at the training to conduct water use efficiency audits on their overhead machines.

Macintyre Valley Field Day 08

When asked to rank the field day (on a scale of 1 to 10, with 10 being the best) overall as a source of information for drought management into the future participants provided an average ranking of 7.6.

Soil Pit Field Day

Participants at the field day learnt about the properties of soil that effect water use efficiency and crop growth via soil pit inspections. It included management options to overcome soil limitations and a demonstration of the Soil Health test kits. Feedback from growers was positive and a number of them identified management options which may be implemented to overcome soil challenges on their respective farms.

In field siphon flow meter demonstration

As a result of this training irrigators were now aware of the impact on irrigation performance of head height and siphon placement on flow rate would ultimately aim to maintain a high head when irrigating to improve irrigation performance on their farm.

Farm walk – irrigation x variety trial (Darling Downs)

Growers and consultants were informed of new plant based sensors as another tool in monitoring soil moisture. Lively discussion and interaction of the three irrigation strategies and single skip component irrigation strategies implemented and their applied water were discussed. As a result participants are looking forward to the final results from the demonstration site to see if changes can be made on-farm to improve WUE. The low numbers of growers is a reflection of the current morale in the industry given low cotton prices and poor water supplies.

Cotton BMP Workshop

The workshop provided the four participating cotton consultants with advice on the practical application of the Cotton BMP by their clients. This will further aid the adoption of Cotton BMP on the Darling Downs.

Storage Compaction Field Day

This involved extensive collaboration with the Central Downs Irrigators, Condamine Alliance and Landcare. Participants observed the differences in compaction treatments on the floor of an empty storage by four different compaction treatments. They also received presentations from several speakers on various topics related to compaction. Participants were able to observe how density tests were carried out from SQ Soils and discuss procedures and techniques with associated personnel.

Surface Irrigation Performance Evaluation Workshop

Agronomic consultants were provided training on the theory underpinning furrow irrigation optimisation and the opportunity to interpret data from their own furrow evaluations. As a result, consultants now have the knowledge and understanding to provide future system evaluations as part of their irrigation service for clients.

Learning's and Future

Irrigation Training workshops are effective in providing irrigators and consultants with the knowledge, skills and confidence to implement practice change on farm. On going delivery of training workshops post RWUE3 will be critical to the success of the irrigation industry in implementing best practice on farm.

Grower and consultant participation in workshops are affected by seasonal conditions and timeliness of events.

Photo 17 Peter Smith, NSW DPI presents at Dalby CPLM Training Workshop, 22 November 2007

Key Achievements - System Evaluations

Background

The RWUE3 team performed irrigation system evaluations as part of demonstration sites on a regional basis. The system evaluations were performed to demonstrate best irrigation management practice and promote the adoption of this practice on-farm through a participatory action learning model and encourage use of irrigation consultancy services by Irrigators. The evaluation data collected forms part of the data collated in the Irrigation Performance and Reporting Tool (IPART) for centre pivot and lateral move evaluations and ISID for furrow irrigation evaluations.

Objectives

- Irrigated Cotton and Grain growers and agronomic consultants in Queensland will use developed tools and information/learning's to assess current performance and make changes where needed in irrigation management
- Irrigated Cotton and Grain growers and agronomic consultants will have increased knowledge and skills about improved water management/WUE at a whole farm level
- An increase in commercial demand by irrigators for irrigation consulting and the number of consultants to undertake this task

Targets

- 6 full irrigation system audits
- 6 irrigation tours
- One consultant in each identified irrigation district certified to conduct system checks on centre pivot and lateral move irrigation systems

Status

Centre Pivot and Lateral Move Evaluations

To date there have been 46 centre pivot and lateral move evaluations completed (39 of these during the term of RWUE3). The data from these has been entered into IPART. Four of these were conducted by Justin Schultz of EA systems in order to build capacity within the industry.

Articles published in relation to these evaluations include:

- 5 articles published in the Australian Cotton Grower
- 3 articles in More Profit Per Drop
- 2 articles on the Cotton and Grains web site.

Two Centre Pivot and Lateral Move CRC IF training workshops have been delivered (39 participants), along with three Centre Pivot Lateral Move Field Days (55 participants).

36 growers (34 during the term of RWUE3) have been directly involved in the Centre Pivot and Lateral Move evaluations.

Surface Irrigation System Evaluations

The RWUE3 have contributed significantly to the 100 furrow irrigation evaluations reported in ISID. These were undertaken as part of the demonstration trials established across 18 sites and included in training conducted by RWUE3. Communication related to surface irrigation evaluations have included:

- 5 Australian Cottongrower articles
- 1 Cotton Conference paper
- 5 More Profit per Drop articles
- 1 Cotton and Grains website article

One Surface Irrigation Performance Evaluation Workshop delivered to 5 participating consultants. 25 growers and 16 consultants have been directly involved in the system evaluations conducted as part of the demonstration sites.

Results

The ISID database includes 100 in field surface irrigation evaluations in Queensland, including those conducted as part of RWUE3 demonstration sites. The results of these are summarised in Figures 3, 4 and 5, and in Table 16.

The IPART database currently reports on 46 overhead system evaluations conducted as part of Rural Water Use Efficiency. The details of these and the results are reported in Figures 10 and 11.

Learning's and Future

System evaluations are critical to collecting benchmark data for the irrigation industry and are valuable in directly involving growers and consultants in quantifying their water use. The resultant knowledge and skills gained from system evaluations aids the implementation of practice change on farm.

Photo 18 RWUE3 officer Jenelle Hare and local consultant Murray Boshammer, TAGS measuring catch can volumes during centre pivot evaluation

Key Achievements - Presentations

Background

The RWUE3 team delivered a number of technical presentations at RWUE Field days along with other industry events, promoting Irrigation best practice through the delivery of demonstration results and technical information updates.

Objective

Irrigated Cotton and Grain growers in Queensland and Nth NSW and agronomic consultants will have increased knowledge and skills about improved water management/WUE at a whole farm level

Targets

- 95% (cumulative) of industry enterprises have received information about improving water use efficiency.
- 75% (cumulative) of producers have been directly involved in RWUE3 activities.

Status

- 13th ACGRA Australian Cotton Conference 8-10th August 2006. The following activities undertaken at the Conference: Hands-on-Research session “Storages Management.” Approximately 26 participants had their questions answered by speakers who have first-hand experience with identifying and addressing seepage problems and losses through dam floors and walls. Remediation practices and technologies were discussed. Hands On Research Session “Whole Farm Water Balance” with Cotton CRC water team
  - Sarah Hood and E Carrigan presented a paper on “Siphon-less Irrigation”
  - Graham Harris presented a paper on “Best Water Practice”
- Central Downs Irrigators Ltd AGM, Cecil Plains, 26 Sept 2006. Graham Harris presented an update on RWUE3 and the Storage Seepage project to around 40 participating growers
- MacIntyre Valley Cotton Consultants Australia meeting, 16 Nov 2006. Emma Carrigan updated 16 consultants on RWUE3 activities and opportunities for the 2006-07 season.
- A RWUE3 breakfast farm walk was held at the irrigation strategy by variety demonstration site at Dalby on the 13 April 2007. There were 23 participants (of these, 4 were growers and 12 were consultants or from agribusiness). An overview of activities and preliminary results were presented to the group. Growers and consultants were informed of new plant based sensors that are currently being evaluated as another tool in monitoring soil moisture. Lively discussion and interaction within the group occurred as the different irrigation strategies implemented and their applied water were discussed. Participants were invited to look at the three strategies and single skip component. As a result participants are looking forward to the final results from the demonstration site to see if changes can be made on-farm to improve WUE. The low numbers of growers is a reflection of the current morale in the industry given low cotton prices and poor water supplies.
- 14th Australian Cotton Conference 2008. The RWUE team promoted the RWUE3 project through their involvement in running three of the hands on research workshops (70 participants):
  - Hands on Research session - Storage Management. Graham Harris (QPIF), Jim Purcell (Aquatech Consulting) Nathan Heinrich (FSA Consulting), Andrew Watson (Grower), Greg Morris (ACGRA). Outcome - increased awareness of storage management including measurement and remediation of evaporation and seepage losses

- Hands on Research session; Lateral Moves and Centre Pivot Systems, Lance Pendergast (QPIF), David Kelly (ACGRA), Ross Ecroyd (Valmont International) Merv Jessen (IAL), Matt Mitchell (Hillston grower), Mal Pritchard (Agronomist, Hillston). Outcome - Increased awareness of overhead irrigation systems
- Hands on research session - Sub surface drip irrigation, Lance Pendergast, David Kelly (ACGRA), Peter Durand (Netafim), Jay Dhungel (PhD scholar, CQU) & James Hill (NSW DPI/Cotton CRC). Outcome - Increased awareness of subsurface drip irrigation

- Graham Harris presented 'Training and resources for irrigated grains' at the GRDC Summer Crop Update, Dalby, 19th & 20th August 2008 (30 growers and consultants)
- Graham Harris presented 'IPART: Irrigation Uniformity Assessment Tool" to the Irrigation Australia Limited Energy in Irrigation –Seminar and Field Inspections, Goondiwindi, 2008 (50 participants)
- Graham Harris presented "Irrigation in the Tropics" at the North Western Queensland Agribusiness Forum, Gregory Downs, 2008 (30 participants)

Photo 19 Local grower Brett Crothers discusses experience with his centre pivot at Dalby CPLM Training Workshop, 22 November 2007

Results

Table 25 summarises the level of participation by growers and consultants in the presentations made by RWUE3 staff.

Table 25 Summary of RWUE3 presentations

Event	Presentation	Date	Growers	Consultants	Others	Total
Australian Cotton Conference	Siphonless Irrigation	Aug 06				300
Australian Cotton Conference	Best Water Practice	Aug 06				300
Australian Cotton Conference	Hands on Research	Aug 06				26
Central Downs Irrigators Ltd AGM	Storage Seepage Project	Sept 06				40
Cotton Consultants Australia, Macintyre Valley	RWUE3 Update	Nov 06	16			16
RWUE3 Farm Walk	Irrigation strategy by variety	April 07	4	12	7	23
Australian Cotton Conference	Hands on Research	Aug 08				70
GRDC Summer Crop Update	Training and resources for irrigated grains'	Aug 08				30
IAL Energy in Irrigation –Seminar	IPART demonstration	2008				50
North Western Queensland Agribusiness Forum	Irrigation in the Tropics	2008				30

During the Hands on Research sessions at the 13th Australian Cotton Conference a number of participants expressed interest in following up the process so that storages could be checked in other cotton growing regions.

At the RWUE3 Farm Walk growers and consultants were made aware of new plant based sensors as another tool in monitoring soil moisture. There was lively discussion and interaction on the three irrigation strategies, and single skip irrigation strategy, and the applied irrigation. As a result

participants are looking forward to the final results from the demonstration site to see if changes can be made on-farm to improve WUE.

As a result of the Sustainable Irrigation Project presentation the RWUE3 staff secured funding and grower in-kind contribution to continue the project for the 2006-07 season, generating industry benchmark data and further optimisation of alternate irrigation systems.

Learning's/Future

Presentations of technical irrigation information to irrigators and consultants reaches abroad audience and further effort and priority need to be place on this extension method.

Photo 20 Lateral Move Field Day at Bob Bellert's, Norwin, 17 August 2006

Key Achievements - BMP/NRM Groups

Background

The RWUE3 team have provided technical support to Cotton BMP and have developed an Irrigation Benchmarking tool to support the implementation of the Cotton BMP Land and Water module. The RWUE3 team have aligned training activities including the Irrigation Benchmarking and Water Budgeting workshop along with all workshops and demonstrations to promote best practice to support the implementation of the BMP program on farm. The Cotton BMP has been under re-development throughout RWUE3 and will be released as the new myBMP later in 2009.

The RWUE3 staff worked closely with their respective NRM Groups to implement incentive schemes which enhance the adoption of more water use efficient practices. These regional bodies have been:

- Border Rivers - QMDC and Border Rivers-Gwydir
- Darling Downs - Condamine Alliance
- Central Queensland - CHRRUP

Objective

Industry able to demonstrate their environmental credentials

Target

- Developing on-farm tools that interact with electronic Cotton BMP
- Relationship between electronic version of BMP and WUE on farm tools determined
- Report against on-farm achievement of regional NRM priority activities, defined with regional NRM groups

Status

WUE Benchmarking Tool

A web-based tool enabling irrigators and their consultants estimate the standard WUE Indices established for the cotton and grains industries. This tool is available for use by the industry as part of the Cotton BMP process. Use of the tool is demonstrated in the Irrigation Benchmarking and Water Budgeting workshop delivered as part of the Cotton and Grains Workshop series. By February 2009 there had been 35 users on 97 occasions and 3 users had registered to provide their data for industry use.

Cotton and Grains Irrigation Workshops

The RWUE3 team have delivered Irrigation Training Workshops developed under the NPSI funded Knowledge Management in Irrigated Cotton and Grains (Phase 2) project to 95 participants across Queensland. The Cotton and Grains Irrigation Training workshops have been integrated with the existing Cotton BMP Land and Water module. Delivery of this workshop series will go a long way towards achieving this outcome target.

Consultant Mentoring Project - Condamine Alliance

RWUE3 on the Darling Downs have been collaborating with Sarah Hood as the project consultant in a Condamine Alliance funded project “Delivering increased adoption of best management practices in water use efficiency to the cotton industry in the Condamine catchment”. The project has successfully integrated into the Cotton CRC water team extension activities on the Downs,

Cotton Australia BMP program and the wider NPSI knowledge management project aiming to increase the capacity of agronomists to deliver irrigation services across the entire cotton industry.

Ten consultants were engaged in the project. Collectively they have 98 clients outside of the 15 growers directly involved in the project. This indicates the post project potential if the consultants incorporate their new skills in irrigation services offered to clients. The majority of consultants chose field irrigation efficiency (both furrow and overhead) as their research priority. Some also opted to include whole farm benchmarking. Training delivered: one consultant participated in WaterTrack Rapid™ training and five in the Surface Evaluation Irrigation Training workshop.

Of the 15 growers engaged six had no previous activity in the BMP program, four had previously completed pre-certification assessments (PCA) for modules 1 to 5, while 2 had completed PCAs for modules 1 to 7. In the 2008-09 season carry-over funds from the project were used to fund 50% of the cost of furrow optimisation work by Landmark agronomists The Condamine Alliance project incentive scheme has received seven expressions of interest to date and contracts will be finalised by 31st December 2008. RWUE3 extension officers are developing case studies to demonstrate the success of this program. Total investment by Condamine Alliance in this project has been $60,000 in incentives. The value of grower in-kind was $55,000 with grower cash contribution totalling $65,000.

Border Rivers Incentive Scheme

In the Border Rivers Emma Brotherton has supported the application process attached to the QMDC incentive scheme in the region. In the 2006-07 season 55 growers accessed $1.1 million of WUE incentive funds through the Border Rivers-Gwydir CMA for EM surveys, storage surveys and on ground works over 15,000 ha. RWUE3 submitted an application to the Community Water Grants for East Goondiwindi area wide management group seek funding for WUE activities in conjunction with Patrick Jones Consulting 2006, although the application was unsuccessful.

Central Queensland

In Central Queensland, Lance Pendergast has been consulting with CHRRUP to enhance collaboration. The outcome of past CHRRUP incentive schemes were reviewed to aid in the development of future schemes. After extensive grower consultation, the need to encourage increased investment in monitoring both pumping and storage status was identified. An incentive package was developed to address this. Growers have been invited to participate in the scheme that provides a 25% subsidy for the purchase of metering equipment. Seven applications are currently (12 May 2009) being finalised and will be submitted to CHRRUP for acceptance. A similar package has been accepted in principle by the catchment management group in the Dawson Callide region (DCCA) and to date two growers have voiced their intention to participate.

Results

Figure 12 summarises the adoption of the Cotton BMP program's Land and Water Management module over the course of RWUE3.

Cotton Australia have indicated that there are currently 10 other growers who have completed a Pre-Certification Assessment (PCA) for the Land and Water Management module. Currently there is no benchmark data available for water management through the BMP program. However, the implementation of the electronic myBMP should provide this data into the future.

Table 23 summarises the participation by RWUE3 in natural resource management WUE incentives through the NRM Catchment Groups.

Figure 12 Queensland adoption of Cotton BMP Land and Water Management module

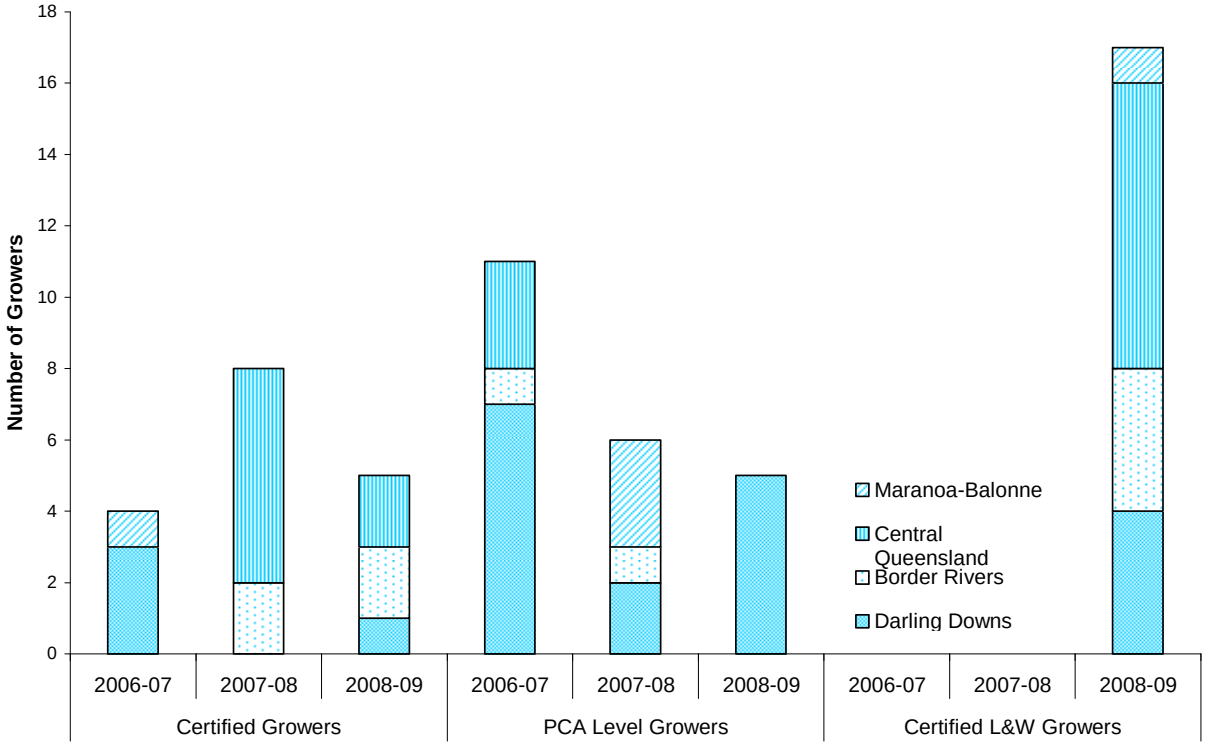


Photo 21 Storage Compaction Field Day at Jan Lafrenz's, Cecil Plains - 18 August 2006

Table 26 RWUE3 participation levels in NRM WUE Incentives

NRM Body	Region	Participants	$ Invested	Outcomes
Condamine Alliance	Darling Downs	24	$185 000	Enhanced capacity of 6 crop consultants to deliver irrigation services
Border Rivers Gwydir CMA	Border Rivers	55	$1.1 million on15,000 ha	EM survey, storage surveys and on-ground works
East Goondiwindi Area Wide Management	Border Rivers	7	Nil	Application unsuccessful to Community Water Grants
CHRRUP	Central Queensland	17	Pending	
TOTAL		103		

Learning's and Future

The electronic Cotton Best Management Practices program (myBMP) is currently under development. Once myBMP is released there is potential to increase adoption of this by the industry.

Collaboration with Cotton Australia and NRM bodies is an effective way to create momentum in WUE – through various extension tools developed under the project that promote and support best practice and the provision of incentive schemes in maximising the environmental credentials of the industry

Budget/Costs

Original Amount: Five hundred and seventy five thousand, eight hundred and fifty dollars ($575,850) (inclusive of GST).

The Amount added through the variation: Seven hundred and ninety two thousand dollars ($792,000).

One Million three hundred and sixty seven thousand and eight hundred fifty dollars ($1,367,850) (inclusive of GST).

Discussion

The lack of irrigation water availability across the cotton industry in Queensland, in some cases during the course of RWUE3 had two contrasting effects. Firstly, there was an increased perceived need for the adoption of WUE practices by irrigators. Secondly, low morale by irrigators resulted in a lack of enthusiasm and participation by irrigators in RWUE3 activities in some years – indicated by the decreased level of participation in those years.

Competition of labour resources due to the buoyant mining sector reduced the participation by growers and consultants as they had less time available with fewer staff resources. However, this increased the interest in labour saving technologies such as siphon-less irrigation (overhead systems, bankless channels).

By this third phase of the RWUE programs many irrigators have already implemented improvements in their irrigation practices. These innovators have continued participation as part of a continuous improvement cycle – they are usually the ones participating in activities to keep up to date with latest innovations.

BMP is being updated to myBMP (which will be electronic and enable on-going collection of the extent of best management practices within the industry). The redevelopment of BMP over the course of RWUE3 has made it difficult to provide technical support to its delivery. However, RWUE3 staff have been integral in updating the water component of the new myBMP.

Despite the loss of some staff resources within RWUE3 (Emma Brotherton's maternity leave and 30% of Graham Harris's time to leadership of The Farm Program in the Cotton Catchment Communities CRC) the team have successfully achieved the planned objectives of the project. This has been possible through the contribution of Mark Hickman, National Cotton Training Co-ordinator and the engagement of commercial consultants as part of capacity building within the industry.

Conclusion

The RWUE3 team have successfully provided the cotton and grain irrigators with the necessary knowledge and skills to adopt and implement irrigation best practice on farm. This has in turn led to more efficient irrigation practices reflected in increased production per ML. The use of irrigation best management practices has enabled cotton and grain irrigators demonstrate their environmental credentials – something that will be further enhanced by the release and implementation of myBMP. This will also enable improved documentation of the extent of best practices within the industry.

The RWUE3 team have continued to support the industry in achieving continued improvements in WUE. This is reflected in the 27 per cent improvement in IWUI within Queensland between 2002-03 and 2006-07 (see Table 4). Data from the demonstration sites during RWUE3 show the significant improvements being obtained as a direct result of adopting irrigation best management practices promoted by RWUE3 staff – significant improvements in both GPWUI and IWUI are reported.

Current industry performance is GPWUI = 1.13 bales/ML and IWUI = 1.58 bales/ML. Therefore the target of 15% of irrigators achieving an IWUI of 2 bales/ML remains aspirational. Achievement of a IWUI target of 2 bales/ML is only possible where irrigators have made significant investments in new irrigation infrastructure (as demonstrated by the IWUI values achieved for drip and overhead system irrigation in the RWUE3 demonstration sites, and by commercial irrigators using these systems). For surface irrigation systems a more realistic target of GPWUI = 1.39 bales/ML and IWUI = 1.5 bales/ML should be set. This appears achievable based on our current knowledge. It should also be remembered that there is significant variability in the IWUI figure driven by the seasonal conditions experienced from year to year. Other measures should also be considered – particularly those related to achieving the highest possible application efficiencies for all irrigation systems being used.

Recommendations

- Use of Participatory Action Learning Model by regional irrigation extension officers to implement practice change on farm through the benchmarking of current irrigation system performance
- Implement an ongoing, coordinated communication effort to keep current and accurate technical irrigation information (including costs: benefits and information on practices) readily available
- Continue promotion and training in the use of available benchmarking tools developed under RWUE3
- Continue evaluation of overhead irrigation systems as a priority. This requires:
  - Promotion of the need for these for existing and new CPLMs to irrigators
  - Engagement with commercial suppliers of CPLMs
  - Collaboration with the two existing engineering consultants who can provide this service.
- On going delivery of training workshops post RWUE3 will be critical to the success of the irrigation industry in implementing best practice on farm. Given the difficulty with attracting participants in some districts we believe new technologies should be investigated as a delivery mechanism i.e. webinars
- More R&D on the agronomics of irrigated crops would aid in the extension of best management irrigation practices across industries. Information on the economics of these needs to be generated and extended also.

Photo 22 Energy in Irrigation Field Day at Goondiwindi, 27 August 2008

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APPENDIX 1 CottonTales Newsletter Articles

	Issue	Date	Article
2006-07			
BR	2	17/11/06	Evaporation
BR	3	24/11/06	Timing of first irrigation and limited water scenarios
BR	4	8/12/06	Incentives for irrigation evaluations
BR	4	8/12/06	Limited Water Options 06/07
BR	4	8/12/06	Water use and Scheduling of Bollgard II
BR	6	18/12/06	Limited Water Options 06/07
BR	12	29/6/07	Border Rivers Gwydir CMA Water Use Efficiency Incentive Schemes for 2007/08
BR	12	29/06/07	CRC Irrigation Futures – Centre Pivot and Lateral Move Irrigation Systems
BR	12	29/06/07	Cotton Grains Irrigation Training Benchmarking Workshop
BR	13	8/7/07	Cotton and Grains Irrigation Workshop Series
BR	14	17/7/08	Dry storage management
CQ	4	16/11/06	Crop water use
CQ	5	2/2/07	Welcome to new staff
DD	1	5/4/07	Breakfast Farm Walk Invitation
DD	2	8/5/07	Cotton and grains irrigation workshop series
2007-08			
BR	2	27/8/07	Limited water and planting decisions
BR	3	9/10/07	DAFF: Support funding for irrigators
BR	5	26/10/07	Capacitance moisture probes
BR	5	26/10/07	Irrigators in the Murray-Darling Basin
BR	7	9/11/07	Presentation on Pilot Program for on-farm irrigation efficiency
BR	7	9/11/07	Cotton & Grains Irrigation Website
BR	11	10/3/07	Knowledge management in irrigated cotton and grains
CQ	1	21/8/07	New Website (Irrigated Cotton and Grains)
CQ	4	6/9/07	Limited water and planting decisions
CQ	7	11/10/07	Capacitance Moisture Probes – do probes need to be calibrated in the field?
CQ	9	2/11/07	CQ Cotton Farming Systems Trial
CQ	10	8/11/07	Waterlogging
CQ	11	15/11/07	Cotton and Grains Irrigation Workshop Series
CQ	12	27/11/07	High yielding irrigated grains in cotton farming systems
CQ	14	18/12/07	Irrigated summer cropping options
CQ	15	2/1/08	Farm management that affects fibre quality
CQ	16	16/1/08	Timing of last irrigation and defoliation
CQ	17	28/2/08	WaterTrack Rapid™ demonstrations
CQ	21	7/4/08	Last Chance! WaterTrack Rapid™ Demos
CQ	22	19/5/08	Irrigated Chickpea in CQ
DD	1	30/7/07	The first Cotton and Grains Irrigation Workshop comes to the Downs
DD	1	30/7/08	CRCIF Centre pivot and lateral move training course
DD	2	17/8/07	Benchmarking Workshop
DD	3	30/8/07	Cotton production with limited water
DD	4	14/9/07	Irrigated Cotton and Grains Workshop Series
DD	6	15/10/07	DAFF drought support funding for irrigators
DD	7	29/10/07	Irrigation management $20,000 Grant
DD	7	29/10/07	Irrigated Cotton and Grains Workshop Series
DD	9	18/12/07	Calling for volunteers to Benchmark Water Management

DD	11	4/2/08	Farm management that affects fibre quality
DD	11	4/2/08	Irrigation management grants
DD	11	4/2/08	Reminder – Benchmarking water use in the cotton industry
DD	14	17/3/08	Groundwater systems workshops
DD	14	17/3/08	Knowledge management in irrigated cotton and grains
LB	1	3/9/07	CRCIF Centre pivot and lateral move training
LB	2	1/10/07	New Website (Irrigated Cotton and Grains)
LB	2	1/10/07	Drought funding for irrigators
LB	3	26/11/07	Management of a dry storage
2008-09			
DD	1	31/07/08	Promotion of Energy in Irrigation Seminar
DD	1	31/07/08	Promotion of Overhead system checks
DD	1	31/07/08	Irrigated Wheat – Irrigation management and in crop nutrition
DD	1	31/07/08	Irrigated Wheat - Growth Stages of cereals
DD	2	10/09/08	Cotton and Grains Irrigation Workshops
DD	2	10/09/08	Promotion of incentive money available to irrigators
DD	3	01/10/08	Planting Considerations
DD	3	01/10/08	Overhead system checks
BR	1	18/09/08	Cotton and Grains Irrigation Workshops
BR	1	18/09/08	Promotion of incentive money available to irrigators
BR	2	09/10/08	Planting Considerations
BR	2	09/10/08	Overhead system checks
CQ	1	2/7/08	Irrigated wheat
CQ	1	2/7/08	Irrigated soybeans
CQ	1	2/7/08	Cotton and grains irrigation website
CQ	1	2/7/08	Free overhead system checkups
CQ	9	19/11/08	Promotion of Centre Pivot & Lateral Move Evaluations
CQ	9	19/11/08	Irrigated chickpea planting dates and scheduling
CQ	9	19/11/08	Tender for Storages project
TOTAL	**71**		

BR = Border Rivers; CQ = Central Queensland; DD = Darling Downs; LB = Lower Balonne

APPENDIX 2 More Profit per Drop e-newsletter articles and usage

Issue	Article	Unique Individuals	% of Numbers Opened
1	Siphonless Irrigation Project	41	13%
1	Cotton and Grain Irrigation Workshops	44	14%
1	Current Research and Extension Projects	26	8%
1	Do you know your WUE?	52	16%
1	Oxygation: Enhancing Drip Performance	42	13%
1	Surface irrigation - are you efficient?	55	17%
2	CPLMs - Profitable or not?	53	20%
2	Siphonless Irrigation Project	31	12%
2	Capacitance Probe Calibration	23	9%
2	Drip Irrigated Cotton Demonstrations	26	10%
2	RWUE3 Variety x Irrigation Trial 2006-07	17	6%
2	Cotton and Grains Irrigation Workshops	18	7%
3	Improved Furrow Irrigation Performance	44	14%
3	Why Evaluate Surface Irrigation Systems	32	11%
3	Current Research and Extension Projects	30	10%
3	Use ET to Estimate Water Use	29	10%
3	Irrigation Management Grant	13	4%
3	Cotton and Grains Irrigation Website	52	17%
4	Cotton CRC on Farm Storages Project	24	11%
4	Leaky Storages - What are the Options?	43	19%
4	Deep Drainage - Myth Busters	59	27%
4	High Yielding Grains Project	26	12%
4	Cotton and Grains Irrigation Website	35	16%
5	Centre pivot tests reveal surprising results	28	13%
5	Saving irrigation water, the environment and money	34	15%
5	Increasing yield of irrigated wheat in Queensland and Northern NSW	29	13%
5	Cotton and Grains Irrigation Website	23	10%
5	Toward better water management of Bollgard II cotton	22	10%
5	Irrigation scheduling of cotton based on thermal leaf optima	16	7%
Total	29 articles/updates	938	