



Report to:

The Department  
of Natural  
Resources and  
Mines  
Queensland



# Evaluation of the Rural Water Use Efficiency Initiative Adoption program



**Dr Jeff Coutts**

**Coutts J&R**

17 Manor Street  
Toowoomba  
Qld 4350

[www.couttsjr.com.au](http://www.couttsjr.com.au)

**Survey Analysis & Report**

**Kerry Bell**

Department of Primary Industries  
Queensland

>> **Disclaimer**

Although every effort is made to accurately capture, record and appropriately analyse information contained in this document, its accuracy is subject to the limitations of the methodologies used and described within. Coutts J&R Pty Ltd do not assume liability of any kind whatsoever resulting from any person's use or reliance upon the content of this document.

# Contents

<b>Summary</b> .....	<b>3</b>
<b>Terms of Reference</b> .....	<b>6</b>
<b>Background to RWUEI</b> .....	<b>7</b>
<b>The Barraclough framework</b> .....	<b>10</b>
<b>Methodology</b> .....	<b>16</b>
<b>Results</b> .....	<b>16</b>
Level of Participation .....	16
Best Management Practice.....	17
Water Use Efficiency .....	19
\$ benefits to industries.....	21
Reliability of results and calculations.....	22
Influence of RWUEI activities on changes reported.....	24
Impact and influence of other measures and programs on WUE .....	25
Other factors influencing outcomes .....	26
Climate .....	26
Markets and deregulation .....	27
Disease.....	28
Benefit/cost analysis .....	28
Direct Dollar Values .....	29
Other Costs and Benefits.....	34
<b>Discussion</b> .....	<b>36</b>
Effectiveness and impact .....	36
Participation .....	36
Practice change .....	36
Water Use Efficiency .....	37
Dollar benefits .....	37
Other impacts and benefits.....	38
Momentum to change .....	38
Contributing Beneficial Factors.....	39
Limiting factors.....	42
Future and scope for further improvement .....	44
<b>Conclusions</b> .....	<b>45</b>
<b>Recommendations</b> .....	<b>46</b>

# Contents

<b>Appendices</b> .....	<b>47</b>
A. Sugar Industry Report .....	48
Industry context .....	49
R&D Projects .....	49
RWUEI structure .....	51
Social indicators .....	52
Best Management Practice .....	53
Water Use Efficiency .....	54
Issues and Learnings .....	55
Future .....	56
B. Fruit and Vegetables Industry Report.....	57
Overall statement about the project outcomes .....	58
Industry context .....	58
R&D Programs.....	59
RWUEI structure.....	61
Social indicators .....	62
Best Management Practice .....	64
Water Use Efficiency .....	66
Other impacts .....	68
Issues and Learnings .....	68
C. Cotton and Irrigated Grain Industry Report.....	69
Industry context .....	70
R&D Projects.....	70
RWUEI structure.....	72
Social indicators .....	73
Best Management Practice .....	73
Water Use Efficiency .....	74
Other impacts .....	76
Issues and Learnings .....	76
Future .....	77
D. Dairy and Lucerne Industry Report.....	78
Industry context .....	79
R&D Programs.....	79
RWUEI structure.....	80
Social indicators .....	81
Best Management Practice (BMP) .....	82
Water Use Efficiency .....	84
Other impacts .....	85
Issues and Learnings .....	86
Future .....	86
E. Financial Incentive Scheme.....	87
Applications and approvals/rejections by industry.....	87

# Contents

F. Summary and Analysis of RWUEI Grower Survey 2003 .....	91
Summary of responses.....	91
Statistics.....	92
Summary of survey questions.....	93
G. Goulburn-Murray table of Economic and Employment Benefits .....	114
H. Methodology .....	115
1. Desk-top Review.....	115
2. Guidance and Support for Industry Milestone Reports.....	115
3. Collation and Analysis of Data from Industry Milestone Reports.....	115
4. Telephone survey.....	115
5. Analysis of Financial Incentive Scheme Data .....	116
6. Participation in Workshop with project staff and industry .....	117
7. Member Checking .....	117
I. Benefit Cost Rationale.....	118
J. Publications consulted.....	120

# Acronyms

<b>ABS</b>	Australian Bureau of Statistics
<b>AFFS</b>	Agency for Food and Fibre Sciences
<b>APSIM</b>	Agricultural Production Systems sIMulator
<b>BCR</b>	Benefit/Cost Ratio
<b>BMP</b>	Best Management Practice
<b>BSES</b>	Bureau of Sugar Experiment Stations
<b>COAG</b>	Council of Australian Governments
<b>CRDC</b>	Cotton Research and Development Corporation
<b>CWI</b>	Cane Water Index
<b>DPI Q</b>	Department of Primary Industries, Queensland
<b>E&amp;A</b>	Extension and Adoption
<b>EPA</b>	Environmental Protection Agency - Queensland
<b>FIS</b>	Financial Incentive Scheme
<b>GIS</b>	Geographic Information System
<b>KASA</b>	Knowledge, Attitudes, Skills & Aspirations
<b>LWMP</b>	Land & Water Management Plan
<b>ML</b>	Mega Litres
<b>NR&amp;M</b>	Department of Natural Resources and Mines, Queensland
<b>QFVG</b>	Queensland Fruit and Vegetable Growers
<b>R&amp;D</b>	Research and Development
<b>ROP</b>	Resource Operations Plan
<b>RWUEI</b>	Rural Water Use Efficiency Initiative
<b>WRP</b>	Water Resource Plan
<b>WUE</b>	Water Use Efficiency

# Acknowledgements

An important source of data for this report came from the extensive monitoring and evaluation undertaken by the RWUEI Industry Coordinators from the Horticulture, Cotton & Grains, Sugar and Dairy & Lucerne Industries and their teams. Their Milestone Reports should be read in full to capture the complete flavour of the activities and impact of the Initiative in their respective Industries. The Industry Coordinators along with staff from NR&M Queensland also critiqued this report prior to its finalisation. The irrigators who participated in the RWUEI and those who responded to the survey accompanying this evaluation also provided valuable input into this report.

# Summary



*With the help from the Water for Profit officers this year, we have been able to conserve our water usage better than in previous years and therefore reduce the cost to us as well. (Far North Queensland grower of avocados, limes and imperial mandarins)*

Discovering what is happening further down in the soil through the use of C-Probes, challenged the *traditional method* of checking the top layer of soil for moisture to see whether the trees needed more water. Learning that different soils use water differently allowed more informed decisions about irrigation techniques.

In conjunction with the Water for Profit team, the productivity of the limes was reported to have improved by 40%. Using the C-Probes and testing for water pressure gave data to indicate the need for changes in practice. The amount of water used was decreased and the frequency of irrigation was increased. As well as the productivity improvement, the quality of the fruit was improved as well.

Further changes to enhance water use efficiency have also been planned. Steps such as upgrading to a fully automated irrigation system (watering during the night to lessen evaporation) are in place.

*Sourced from Queensland Fruit and Vegetable Growers 2003 Milestone Report, Draft June 2003, page 63*

***The picture that emerges from the data collected and analysed for this evaluation is that of a well targeted, very integrated intervention program that was highly successful despite the pressures of drought, deregulation and initial low interest.***

The Initiative achieved an improvement in water use availability in excess of 150,000 ML per year across Queensland irrigation industries (and indicatively well above the 180,000 ML Barraclough target). If the full potential of extra production was realised from this improved water efficiency, an extra \$197 million dollars would be conservatively generated in industry productivity.

The Rural Water Use Efficiency Initiative was a four year, \$41 million, Queensland Government funded program (through NR&M) across the major irrigation industries – sugar; fruit and vegetables; cotton and irrigated grains; and dairy and lucerne. The first phase of the Initiative finished in June 2003.

The purpose of this evaluation was to evaluate the outcomes of the Rural Water Use Efficiency Initiative against the criteria developed by Barraclough and Co in 1999. These criteria are based around three levels: improved Water Use Efficiency; Percentage of irrigators achieving Best Management Practice; and social indicators.

The evaluation included analysis of industry milestone reports and related documentation, an independent and random survey of 200 irrigators across industries and regions, and participation in an industry workshop at the end of the program.

## Conclusions

- i. There is sufficient evidence to show that the original objectives outlined by Barraclough were achieved.
- ii. The Benefit/Cost Analysis demonstrated that there was a good return on public dollars spent with regional and state benefits.
- iii. The Initiative has contributed to changes in the way water use efficiency is valued by irrigators resulting in a strong momentum for further change.
- iv. Other benefits identified included: increased social capacity; reduced need for dam storage; and environmental benefits.
- v. The highly integrated approach of the Initiative including the strong government-industry relationships and the proactive mix between the extension, the Financial Incentive Scheme and the R&D Program were major factors contributing to the success of the program.
- vi. Limiting factors included: the delay in commencement and uncertainty of continuation; insufficient time frames for some of the R&D trials; insufficient private sector involvement; and focus on irrigators.
- vii. There is clear potential to build on this momentum to make further gains - it is noted that the program has been extended for a further two years on a reduced basis.

## Recommendations

1. The RWUEI team should be commended on the success of the program.
2. Future focus should extend further to the private sectors as well as landholders and industry people.
3. The future focus should extend beyond irrigation to include more efficient use of rainwater for rain-fed agriculture.
4. Water Use Efficiency should be put in an holistic context and linked to other farm-improvement initiatives.
5. Any future Financial Incentive Scheme should focus on the most strategic gains in water use efficiency.
6. On-farm extension and targeted group approaches should be continued.
7. Existing R&D projects should be completed and successful trials extended to other areas.
8. Clear realistic goals are needed for the next phase, together with a transparent evaluation process.

# Terms of Reference



The primary purpose of this evaluation is to address the requirements as set out in the report “Performance Evaluation of the Rural Water Use Efficiency Initiative – Adoption Program” by Barraclough & Co.

This report addresses the performance of the four industry managed Adoption Programs: Queensland CaneGrowers for sugarcane; Australian Cotton Co-operative Research Centre for cotton and grains; Queensland Dairyfarmers’ Organisation for dairy and pasture; and Queensland Fruit & Vegetable Growers for horticulture.

The main areas required to be reported on are:

- Improved water use efficiency;
- Percentage of irrigators achieving BMP; and
- Social Indicators

*It was noted that in demonstrating the results of the Adoption Programs of the RWUEI... it would be necessary to separate the effect derived from the above criteria from background trends that could be presumed in the absence of the RWUEI (to the extent that this is possible – this is dealt with later in the report) Some of these trends might be attributable to factors such as the water reform process including the Water Resources Planning Process (formerly Water Allocation and Management Planning process). The process used to derive the net benefits of the RWUEI need to be described, and it will be necessary to provide a comprehensive discussion of external factors and how they are dealt with. One means might be to carry out a limited survey of irrigators to identify the drivers for any improvements that have occurred and the role of the RWUEI in this. In this context, benefits from the Research and Adoption Program and the Financial Incentives Scheme can be considered as contributing to outcomes under the Adoption Programs.*

Feedback from the meeting with NR&M managers in December 2002 indicated that the evaluation should also include consideration of the Financial Incentive Scheme (FIS) and the Research and Development Program. These are covered within the context of how they impacted on the Adoption Program.

# Background to RWUEI

The RWUEI was funded by the Department of Natural Resources and Mines (NR&M) for four years with \$41 million being allocated to the program. These funds were allocated to the program across four areas:

- \$23M to the Adoption Program (extension, development and research) - the focus of this report; and
- \$18M to Reducing Water Losses from Storages on Farm; Financial Incentives to achieve Best Management Practice; and Reducing Water Losses in Irrigation Water Supply and Distribution Systems.

The *Water Use Efficiency Initiative Adoption* and the *Financial Incentive Scheme* programs are managed through the respective industries in partnership with the Department of Natural Resources and Mines. The four main rural irrigation industries are nominated as:

- Cotton & Irrigated Grains
- Sugar
- Horticulture
- Dairy & Lucerne.

***The goal of the Initiative was, by the end of the project (July 2003), to have improved water use efficiency across the nominated industries across the state, so that an equivalent of 180 000 ML more water per year would be available for irrigation purposes*** (Smith 2003).

It was calculated that the potential additional production from this volume of irrigation water would have a value of \$280M per year across Queensland. This equates to a weighted average value of 1 ML of water across industries of approximately \$1555/ML water.

Barracrough and Co reported that the key benefits expected to flow from the improved water use efficiency and management were:

1. By July 2003, an increase in agricultural production of \$280 million (equivalent to what would be achieved by supplying *an additional 180 000 megalitres (ML) of water annually*);
2. The creation of 1,600 jobs in regional Queensland;
3. Improved farm profitability and viability of Queensland's rural industries; and
4. Reduced run-off and drainage of pesticides, salts and nutrients into rivers, aquifers and streams.

The Barracrough report noted that current assessments in Queensland indicated that... *about 60% of irrigation water being used by farms is being used for crop or pasture production with the balance being lost to run-off, drainage or evaporation*. It concluded that even if the initial targets set by industries were achieved...*there would still be opportunity for further improvement as nearly 500 000 ML would still be lost (based on achieving potential gains beyond initial targets)*.

A mid-term evaluation (Coutts & Russell) was undertaken in 2001. It focused on seeking evidence that there is positive movement *towards* set targets – rather than whether targets have been reached. Specific conclusions and recommendations emerging from the review are listed below.

- i. The RWUE Adoption Program is an impressive example of an integrated strategic approach to change management in rural industries. It has achieved a high level of penetration and participation across regions and industries.
- ii. The large uniform industries of cotton and sugar have been able to successfully build onto their existing resources and infrastructure to maximise the impact of the RWUE intervention.
- iii. The Horticulture Industry Adoption Program is facing difficulties because of the diversity and lack of a common extension infrastructure. The Dairy Industry Adoption Program is also experiencing logistical difficulties. Both industries have however made good progress in benchmarking and extension activities despite these difficulties. More assistance may be needed from the RWUEI for these industries.
- iv. The Adoption Program took time to establish and is rightly using resource intensive approaches such as on-farm trials, demonstrations, benchmarking and testing. Some on-farm trials are yet to be established and others will not be completed until beyond the current time frame. There are strong grounds for extending the program for a further period.
- v. The other grounds for extending the current program is based on the premise the easy gains in WUE will have occurred as a result of installing new equipment or relatively less disruptive management practices. The key to long term continuous improvement in WUE lies in changing attitudes, aspirations and paradigms for all involved. This is longer term goal and will require sustained effort – as well as a commitment to participative processes and mutual ownership of programs.
- vi. The technology adoption strategies being used and the range of activities across programs are supported as good extension practice. Increased opportunities for industry teams to learn from initiatives in other industries should be provided.
- vii. Reporting guidelines aligned to the Barraclough Evaluation Plan should be clarified, simplified and streamlined to ensure common and comparable reporting across industries. The table proposed by Kerry Bell should provide a guide for the end-point in capturing and reporting changes in BMP to better calculate changes in WUE.
- viii. A workshop should be held with all RWUE Adoption Program coordinators to work through a revised reporting framework, common monitoring procedures and to initiate a 'practice report' to refine these measures.
- ix. The Financial Incentive Scheme should be reviewed in the light of grower response and delays in accessing the scheme. There is perhaps potential to use the funds differently and more strategically.

In June 2002, a “Synergy Analysis” (Coutts 2002) was undertaken of the program to identify its specific niche in addressing improvement to rural water use efficiency in Queensland. It looked for duplication and complementarity with other programs. A summary of the findings of this study is as follows.

1. The specific niche of the RWUEI Adoption Program is that of directly working with irrigators across the major irrigation industries to improve on-farm water use efficiency.
2. The RWUEI Adoption Program is the only significant project tackling water use efficiency improvement at an on-farm level. It complements the work being undertaken at the systems and water provision levels – for example with determining water allocations, trading and distribution efficiency.
3. There is strong evidence that an on-farm focus is critical to achieving the magnitude of change being sought for on-farm water efficiency savings in a relatively short time.
4. The existing RWUEI field officers are a significant human resource available to Queensland to impact on improvements on water use efficiency.
5. There is no evidence that existing industry organisations or agencies have the resource capacity to provide the same critical mass of field officers devoted to improving on-farm water use efficiency. There appears to be scope for more supplementary funds from industry and federal government sources for specific adoption program activities.
6. The current structure and mechanisms within the RWUEI program is resulting in good interaction between the key players and across industries. There are some opportunities to further strengthen some of these linkages.

# The Barraclough Framework

Barraclough and Co (Aust) Pty Ltd developed a Performance Evaluation Framework for the RWUEI Adoption Program at the commencement of the program.

It was noted in the Barraclough & Co report that a major issue was...*the lack of data relating to the water used for irrigation and information on how efficiently it was being used.* The RWUE project was seen as a vehicle for collecting more accurate data but it was recognised that some information...*would only be available for certain areas in 2003.* For this reason equal emphasis was placed on.....*monitoring changes in attitudes and actions as BMP and WUE.*

The evaluation framework was based around three levels with associated generic measures:

Level	Generic Measures
Equivalent WUE Improvement	<ul style="list-style-type: none"> <li>• Irrigation Water Use</li> <li>• Irrigation Water Use Index (t/ML)</li> <li>• Economic Water Use Index (\$/ML)</li> </ul>
Best Management Practice	<ul style="list-style-type: none"> <li>• Management and Information</li> <li>• Scheduling</li> <li>• Irrigation Systems</li> <li>• Environment</li> </ul>
Social Indicators	<ul style="list-style-type: none"> <li>• Participation</li> <li>• Awareness</li> </ul>

It was recognised that external factors could impact on performance positively or negatively. These included: climate variability; pests and disease; water supply; water quality; R&D support; commodity price and government policies. The degree to which these factors may have impacted on the results of the RWUEI are discussed later in this report.

The WUE targets for the different irrigation industries were reported in the Barraclough as follows:

Industry	Water Use estimate at start of program ML	Target WUE ML Gain per yr	\$/ML Estimate	Target Benefits \$M	Target BMP Adoption	Participation Rates
Sugar	1,211,000	72,660 (6%)	1239	90	70*	Not set
Cotton & Grains	Cotton: 600,000 510,000 Grains: 90,000	60,000 (10%)	450	27/year C: 23/yr G: 2.4/yr	70	Not set
Horticulture	274,493	30,000 (11%)	4900	147	40	Not set
Dairy & Lucerne	D:491,628 L:175,455	58,503 (11%) 9,298 (6%)	145 366	8.5 3.4	40 40	Not set
<b>TOTAL</b>	<b>2,752,576</b>	<b>230,461/yr</b>		<b>275.9/yr</b>		

\* Note that the BMP adoption targets are set as percentages of farmer numbers - \$ benefits are based on a saving over the total industry.

The industry figures used were said to be based on the individual industry proposals – although there appears to be some rounding up and some inconsistencies. For example, it appears that the \$90M target benefit for the Sugar Industry relates to expected gains over the 4 years of the project. The Dairy figure of ML saved per year also differs from the 33,000 included in the proposal. The Horticulture contract refers to savings over four years. Based on his figures, Barraclough noted that...*the total amount exceeds the Initiative's key performance target of 180 000ML/year.* Some information on the background of the industry proposals are included below.

## Sugar

The original proposal from the sugar industry stated that...*the aim of the Water Check project is to increase irrigation and water use efficiency by at least 6 % across the state with 70 % of irrigators (farms) using best management practice (involving both production and environmental issues) specific to their region by 2003. The gains were proposed as occurring over the 4 year life of the Initiative.*

It pointed out that...*the Sugar Industry is a major agricultural industry for both Queensland and Australia with approximately 500 000 hectares under cultivation producing \$ 1.8 billion of raw product. Approximately 50% of the industry relies on some form of irrigation with much of the recent expansion occurring in the irrigated regions. During the recent spate of El Niño years the industry has increased use of irrigation to remain profitable and viable...After reviewing sugar cane irrigation research conducted both domestically and internationally, Dr Graham Kingston developed a model that suggested the maximum water use efficiency for sugarcane could be at least 12 tonnes of cane per megalitre applied (some farmers have achieved this). However after taking into account the likely range of factors to be experienced in practice and assuming an irrigation efficiency of 85% the industry water use efficiency benchmark has been set at a return of 10 tonnes of cane per megalitre of water applied (irrigation and rainfall).*

## Cotton

The project proposal noted that...*Queensland produced 760,000 bales, 28% of the Australian crop, from 138,000 hectares during 1997/98 in the regions of Emerald, Dawson/Callide, Darling Downs, St George/Dirranbandi and the MacIntyre Valley. The irrigated crop produces 663,000 bales with a gross value of \$370 million and represents 87% of the total Queensland crop. Based on water consumption of the cotton industry in 1993-94 of 511,000 MI, a 10% increase in crop water use efficiency of 0.1 bales /MI could result in increased production of 51,000 bales valued at \$23M. ...If a 10% improvement in irrigation water use efficiency in the grains crops, of which the current value of production in Qld has been estimated at \$24.3M by Dr. Bob Miles, then the potential value of the increased production which could be produced is \$2.4M.*

## Horticulture

The industry proposal stated the...*the aim of Water For Profit Project is to increase WUE in the Fruit and Vegetable (F&V) industry by 11% over four years, improve productivity, increase profit and reduce environmental impacts. This was based on an estimated (annual) water savings of 14,817ML and increased production of 86,780 tonnes with a value of \$147,518,901.* This was interpreted by the Industry coordinator, and clarified by the RWUE state program manager that the contractual aims were to be made over the 4 years of the program. Note that the figure in the Barraclough table of \$147 million for 30 000 ML gain is based on \$4900/ML which is a high figure when compared to that of \$515/ML (based on the Goulburn-Murray proposal table in Appendix G). The Industry Coordinator explained that the figure is based on the following:

- *One ML of water saved in efficiencies will contribute to, on average over a basket of horticultural crops, approximately \$4900 of further production, (from Barraclough data). Eg: 10ha of citrus are grown and requires about 6Ml/ha to grow or a total of 60ML. Each ha produces about \$33 000 of product. If, through the RWUE, the grower saves 10% or 0.6 Ml/ha or an additional 6 ML, then he has enough water to supply one more ha, which will give him a return of an additional \$33 000. This is the equivalent of \$5500 per ML water used for additional production.*
- *In horticulture, there is a large range from \$5000 (eg Avocado) to \$20 000/ML (Strawberry) as per Figure 20 of the Barraclough Horticulture report, 1999.*
- *There are a couple of references in Barraclough that compiles the relevant data: Table 10 – “Value of Opportunities” that translates the value of efficiency improvements (thus top \$), has an overall ML saving of 29149 ML with a total value of \$304 284 952 for the complete basket of horticulture production in Qld, or \$10500/ML. Different calculations for the average crop are in Table 8 – “Qualified Opportunities” and gives an average water use of 4.2 Ml/ha and a production value of \$20 729/ha for the complete basket of horticulture production in Qld, or \$4935/ML. Being conservative, the lower of these figures has been used and rounded down to \$4900/ML.*

## Dairy

The dairy industry proposal stated that the ex-factory output (total milk across Queensland) was \$720 million. Of that approx \$131 million was produced from irrigated dairy pasture. The 11% improvement of 33, 000 ML of water was stated to equate to \$8.5 million worth of manufactured milk (this included an un-stated assumption of litres of milk per litres of water).

It was noted in the 2003 Milestone Report that there was a base of 1600 dairy farms in 1990 which dropped to only 1120 in March 2003 as a result of deregulation and drought – equivalent to a drop of 28%. The Industry Coordinator expressed the view that...*it is fair to say that most of those that went out of dairying were irrigators thus with no better figures to go by (no real data of usage on these farms), I reduced the usage of 300,000ML down by 28% to 216,000ML as total usage. If I used 300,000ML and we saved 14% of this, then total saved water would be 46,200ML. The target of 58,503ML was not ever mentioned in the project proposal and we agreed on 11% improvement in efficiency from the 1600 dairies using a total of 300,000 ML of irrigated water which was 33,000 ML. I consider the 58,503 is an unrealistic baseline figure. The base is therefore different with less farms using water.*

## Modified Targets

Based on consultation with the Industry Coordinators and with reference to their initial project proposals for their participation in the Initiative, the modified targets are shown for gains in water use efficiency and \$ benefits to industry in the following table:

Industry	Target WUE ML Gain/year	\$/ML Estimate	Target Benefits \$M
Sugar	18,165 (1.5%)	1239	22.5
Cotton& Grains	60,000 (10%)	450	27
Horticulture	7,500 (3%)	4900	37
Dairy	14,817 (5%)	145	2.1
Lucerne	33,000 (19%)	366	12
<b>Total</b>	<b>133,482</b>		<b>100.6</b>

This is less than the original Barraclough targets, largely because of the difference in understanding in sugar and horticulture that proposal targets were based on gains over the four years of the project rather than on an annual basis.

## Interpreting the targets

A key understanding in this evaluation in interpreting these targets is that they directly relate to one another. The focus is not on how much less water is used on farms per se, but rather how the water that *is used* is used more efficiently towards increased productivity. This is in line with the aim of the initiative as outlined earlier:

*By July 2003, an increase in agricultural production of \$280 million (equivalent to what would be achieved by supplying an additional 180000 megalitres (ML) of water annually).*

The essential aim, in effect, has been to replace the need for a new dam supplying 180,000 ML of water per year to irrigators by improving how efficiently irrigators use the existing water, so that in comparative production terms it is *as if* they effectively have another 180,000ML for production purposes compared to what they had at the start of the RWUE initiative.

Another way of looking at this is that water savings' targets were set with no accompanying loss in production and/or with more efficient water use resulting in increased production from existing "irrigation development". Therefore if the water that was saved in each industry was able to be used for further "irrigation development", the value of that additional production would be equivalent to \$280 million over the state.

# Methodology

The approach used in this evaluation incorporated: a desk-top review; providing guidance and support to industry coordinators in completing their final industry Milestone Reports to best feed into the evaluation; collation and analysis of data from the Milestone Reports; a stratified independent telephone survey across irrigation industries throughout Queensland; an analysis of FIS recipients; a workshop process with program staff and industry; and member checking with the analysis and conclusions that emerge from the data. Full details of the methodology used is included in Appendix H.

## Results

Results are based around the three levels of the Barraclough evaluation framework:

- Level of Participation;
- Best Management Practice Adoption;
- Improvements to Water Use Efficiency; and
- Imputed \$ Benefits to Queensland

The information used in the analysis is drawn from: those reported in the Milestone Reports; the independent irrigator survey; and the Financial Incentive Scheme. The explanation of the figures used from the Milestone reports are contained in the summaries of those reports in Appendices A-E. Comments about the reliability of figures used are made at the end of the results section.

### Level of Participation

There was a wide range of extension activities used in the adoption program. These are detailed in the individual Milestone reports. All industries reported high levels of participation in RWUEI activities. This was supported by the responses to the grower survey.

Level of participation in RWUEI activities

Industry	Milestone reports % involvement	Survey % involvement
Sugar	93%	75
Cotton & Grains	78%+*	76
Horticulture	80-90%**	70%
Dairy & Lucerne	72%	70/63

\*Based on the number reported to be involved in BMP activities

\*\*43% estimated to be involved in workshops etc.

The survey analysis shows the range of activities and participation across industries.

Participation in activities was very high, and as such, can be assumed to have captured farms across the size spectrums. Participation does not in itself necessarily lead to changes in knowledge or understanding. The survey included a question about whether respondents felt they increased their knowledge and understanding about irrigation and water use efficiency and how much they attributed their involvement in the initiative to that increase.

On average each of the industry groups reported that they had improved their knowledge and understanding about irrigation and WUE by between ‘a little’ and ‘a moderate amount’ as shown in the following table:

Changes in understanding and knowledge

Main Income	Not at all	A little	A moderate amount	A lot	Total Respondents	Average Score*	% moderate + a lot
Sugar	12	17	22	15	66	2.6	56%
Cotton / Grains	3	5	13	8	29	2.9	72%
Lucerne	7	3	3	5	18	2.3	44%
Dairy	3	10	12	5	30	2.6	57%
Horticulture	11	11	13	12	47	2.6	53%
Other	3		6		9	2.3	67%
<b>Total</b>	<b>39</b>	<b>46</b>	<b>69</b>	<b>45</b>	<b>199</b>	<b>2.6</b>	<b>57%</b>

\* The levels were set as 1=not at all, 2=a little, 3=a moderate amount, 4=a lot, and the average of these numbers were reported.

Overall there were 57% of respondents who attribute their involvement in RWUEI program activities to changes in thinking by a *moderate* amount to a *lot*. Only 17% did not attribute any of their gains in understanding and knowledge to the Initiative.

It is the changes in understanding and thinking that will have the biggest long-term impact on continuous improvement in water use efficiency.

## Best Management Practice

Best Management Practice was a moving target over the life of the initiative. As new research was being undertaken, Best Management Practice was being modified. A number of tools were used to assess the level of Best Management Practice in some industries against a defined set of practices (for example the sugar industry). In other industries (for example the cotton and irrigated grains) the *process* of being actively involved in working towards Best management Practice was the defining criteria. The following table shows the reported achievement of BMP in each industry and compares this with the respondents to the survey.

Level of Best Management Practice

Industry	Target % growers at BMP	Milestone Reports % growers at BMP	Surveys % growers*
Sugar	70%	85%	68% (88%)
Cotton & Grains	70%	78%**	80% (100%)
Horticulture	40%	45%	70% (89%)
Dairy & Lucerne	40	49% 42%	69% (90%) 73% (78%)

\* based on respondents' own assessment of whether they have no room for further improvements or 'only some improvements possible'. The bracketed figure is the % of respondents who made any changes to their irrigation systems or management over the last 3-4 years.

\*\*"involvement in BMP process".

A large proportion of respondents (90% to 100%) who said they intended to make changes had also made changes over the last 3-4 years, indicating a possible trend that these irrigators are seeing the benefit of improving their irrigation systems or management through prior experience.

Another way of looking at documented practice change is through the Financial Incentive Scheme. Irrigators receiving subsidies through the FIS did invest in improved efficiencies by modifying equipment or management practices. The following statistics from the Financial Incentive Scheme to May 31 2003 shows the documented number of approved and paid irrigators and the amount spent for each industry.

Financial Incentive Scheme irrigators and subsidies

	Cotton (\$)	Dairy, Lucerne And Pasture Industry (\$)	Fruit And Vegetable Industry (\$)	Sugar Industry (\$)
<b>Total Irrigators</b>	588 (42%)	699 (68%)	1438 (41%)	1893 (63%)
<b>Total \$</b>	\$4,354,865.99	\$5,549,933.75	\$6,956,886.33	\$14,556,502

Industry Coordinators indicated a strong linkage between irrigators being involved in activities and applying for subsidies. Survey respondents were asked to indicate how much program activities and how much the Financial Incentive Scheme impacted on their decision to make changes. Overall, 55% of respondents attribute the influence of RWUEI program activities or information on their decision and ability to make changes by a *moderate amount* to a *lot*. In the same way, 86% of respondents attributed the influence of the subsidy to making the changes by a *moderate amount* to a *lot*. This reflects this strong linkage and synergies between the extension and incentive program.

In an official analysis of the figures to May 31 2003, it was noted that...*the Government to date has contributed \$10.5 million, to the FIS element of the RWUEI, with matching investment from landholders being \$31.42 million. For every one dollar Government has invested, the return [or rather the level of additional industry funding attracted] has been three dollars from landholders. This figure is as at 3<sup>rd</sup> March 2003, and the figure is subject to increase by 30 June 2003, as all approved applications have not been paid as at 3<sup>rd</sup> March 2003.*

## Water Use Efficiency

The approach to measuring water use efficiency varied between industries. The Cane Industry used extensive benchmarking and models to calculate changes in the Cane Water Index (tonnes of cane per 1 ML water). Cotton and Grains used benchmarking as well as reported changes in industry statistics related to production. Dairy, Lucerne and Horticulture estimated changes based on the level of first-hand interaction – and hence documentation – to estimate improved efficiencies in water use.

The estimations derived from the industry reports are included in the following table alongside the estimates provided by survey respondents about their own improvements to water use efficiency over the period of the RWUEI. Details on how changes in water use efficiency were estimated are contained in the summaries of the industry Milestone Reports in Appendices A-D.

### Changes in Water Use Efficiency

Industry	Water Use Estimate at start of program	Original Target Improvement to WUE		Milestone Reports Improvements to WUE against original estimate		Survey Improvements to WUE
		ML	%	ML	%	
Sugar	1,211,000	18,165	1.5%	30275	2.5%***	16.5%
Cotton & Grains	600,000	60,000	10%	67,855	11.3%	12.3%
Horticulture	274,493	7,500	3%%	11,073 *****	4%*****	31.5%
Dairy & Lucerne	330,000	14,817*	5%	30580	9.2%	26.9%
	175,455	33,000	19%	12600	7.14%	15.3%
<b>Total</b>	<b>2,590,948</b>		<b>7.9%</b>		<b>5.8%****</b>	<b>18.4%****</b>

\* Dairy target was modified based on the proposal target of 33,000ML

\*\*The 180,000 ML target saved/year was the overall stated initiative goal

\*\*\*The sugar target was affected by yellow rust and drought.

\*\*\*\*weighted averages

\*\*\*\*\*This does not include yield and quality improvements

The survey respondents estimated their improvements over the life of the RWUEI much higher than the estimates provided by industry coordinators in the Milestone reports. This *could be* because the irrigators who responded were the better growers and more comfortable with providing figures required by the survey. It could also be that the RWUEI provided them with assistance in establishing base-line on their properties and in monitoring improvements. It also, however, reflects the conservative nature of the figures provided by the coordinators and the limited data available to arrive at the initial estimates of water usage in the industries. There is a lot stronger knowledge about water use in the industries at the end of the RWUEI than there was in the beginning. Growers, on the other hand, would have had a lot better knowledge of their base-line for their farms and their estimates are more likely to reflect true gains on their particular farms.

The growers who responded to the survey were medium to larger farm sizes as reflected by the averages in the following table.

Average irrigated area of survey respondents

Main Income	min	1st quartile	median	3rd quartile	max	Average area	Number of
Sugar	13	58	94.5	186.25	1900	179.3	68
Cotton / Grains	33	200	395	637.5	3700	561.8	30
Lucerne	8	43.5	58	96.25	200	72.7	18
Dairy	18	30	47	62	300	69.7	29
Horticulture	0.12	3	9	35	400	42.3	47
Other	3	8	48	80	1000	162.9	9
Overall	0.12	27.75	65	180	3700	178.2	201

Given this size range, then the gains in water use efficiency reported in the survey are likely to reflect overall industry improvement.

In the view of the evaluator, the **actual** gains in water use efficiency would be expected to lie somewhere between the estimates derived from the industry milestone reports and those estimated by respondents of the survey – that is between **152,383 ML (7.9%)** and **476,734ML (18.4%)** and **would be in-excess of the Initiative target of 180,000 ML.**

## \$ Benefits to Industries

There have been difficulties at arriving at the estimated economic benefits from the estimated gains in water use efficiency. This is because of the difficulties in clarifying the basis for the original targets, issues associated with the boundaries for calculating the \$ benefits (for example, farm gate or further down the marketing chain) and the variation in logic and multipliers used. There is a further issue of gross returns versus net returns. In this case gross returns are used.

The following table uses a number of approaches to look at the possible economic benefits of the estimated gains in water use efficiency. It uses the boundary of the returns to the industry from the higher potential productivity as much as possible. Extra multipliers could be used to include the flow on benefits down the marketing chain to look at the overall benefit to the State from the extra productivity in these irrigated industries. This has not been done here because of the lack of credible multipliers available to the evaluator.

Estimated \$ benefits to industries

Industry	Target industry gain \$Million	Gain calculated from Milestone reports* \$ Million.	Gain using multipliers in original Barraclough table** \$ Million.	Gain based on % improvements from grower survey*** \$ Million	Gain based on Goulburn-Murray water table**** \$ Million
Sugar	22	9.7	9.2	64	6.3
Cotton & Grains	27	57	30.5	62	14
Horticulture	37	113.3	27.3	884.7	11.5
Dairy & Lucerne	8.5 3.4	7.3 10.4	7.9 4.6	21.2 22.1	12.6 2.6
<b>Total</b>	<b>97.9</b> <b>\$280*****</b>	<b>197.7</b>	<b>79.5</b>	<b>1054</b>	<b>47</b>

\*Note \$ estimates were modified from those actually reported in milestones following further consultation with industry coordinators.

\*\*Calculated by dividing estimated benefit by target ML gains in modified Barraclough table at the beginning of this report and multiplying by gains calculated from Milestone reports.

\*\*\*Based on % gains in efficiency reported in the survey and the same value per ML calculated from the Milestone Reports.

\*\*\*\*Based on the table entitled 'estimate of economic and employment benefits from irrigation included in the appendices. Multipliers for sugar, cotton & grains and lucerne have been based on the 'farm value per 1000 ML' for 'cropping' which would be understating the higher value cropping industries.

\*\*\*\*\*The original target annual benefits included in the Barraclough report based on 180000ML\*\$1500/ML. This is greater than the sum of the individual industry targets where some were modified to reflect the annual gain basis rather than gains over the four years of the project.

It would appear that the industry/farm economic benefits would be greater than those estimates from the Milestone reports (based on the conservative water efficiency improvement estimates compared to the grower survey responses) but less than those based on the survey results themselves. The main conclusion is that \$ benefits are at least in the order of the target benefits of the program.

This figure would be significantly increased if the flow-on benefits beyond the farm gate were considered.

## Reliability of Results and Calculations

The results about improvements to water use efficiency presented through industry reports are very conservative – and this is reflected in the comparison with irrigator survey results. Factors that have influenced this include:

- The original industry water use benchmarks lacked strong data;
- The industry figures were based on estimates of improvements made *during* the project period before all of the impacts could be felt – although the target itself is based on gains from the end of the 4 year initiative period on;
- Some of the approaches used to estimate improvements in water use efficiency at an industry level (as opposed to on-farm level) lacked the sensitivity required to pick up short term changes; and
- Many regions suffered from a severe drought in the later part of the initiative. This works against efficient use of water – as water is used for crop survival rather than maximising efficiency at the time.

Very few farms appear to have had water meters to accurately provide actual changes in water usage across farms from year to year (although a number were installed as part of the RWUEI). Likewise, not all farms in an industry were involved directly in water use initiative activities to the extent of having on-farm measurements of comparative water use. A combination of on-farm measurements, assumptions based on changes in practice and calculations based on system improvements documented through the Financial Incentive Scheme were used. In all industries, considerable on-farm measurement and benchmarking was used.

The Cane Water Index is the accepted measure of gains in productivity and water use efficiency over time. Even though it can be adjusted through models for drought and disease events, its value is in mapping trends over moderate periods of time – not picking up changes on a year-to-year basis. It is likely that drought still had a major impact on the CWI in the final year used to measure gains from the initial benchmark and understated the full potential gains from changes made. A similar case could be made for the industry statistics used to estimate changes to productivity and water efficiency in the Cotton Industry in their Milestone Report. In the report, industry gains made in irrigated grains were not even attempted because of the difficulty in obtaining or estimating industry wide data.

The Horticulture, Dairy and Lucerne approach to estimating changes based on specific knowledge and contact with growers had merit. The estimation of error in the measurements increasing as less was known about farm practices had merit. The most likely result was that changes were under-estimated because of uncertainty about the 'ripple' or flow-on effect to those not obviously involved in activities. The changes in the dairy industry following deregulation obviously affected comparisons to initial benchmarks in terms of total water usage. A reasonable attempt was made to compensate for this.

The survey and the Financial Incentive Scheme analysis demonstrated that there were significant and wide-spread on-ground changes to management systems and irrigation equipment across all industries. These changes were occurring up until the end of the program. As well, 62% of survey respondents indicated that they would be making further changes over the next 2 years. Based on this, the real benefits from activities undertaken during the 3-4 years of the initial phase of the RWUEI would not have expected to peak yet.

Details of how dollar benefits were calculated in each industry are outlined in the relevant summaries of industry milestone reports in the appendices. The conversion of ML water to product and the farm/industry value of that product have been taken at face value in this report. Such conversions and prices will vary from season to season, region to region and in response to markets at any particular time. The figures therefore are 'ball-park' averages based on Industry Coordinators' best estimates at the time. It is assumed that they are in as good a position to make this estimate as anyone, but they are contestable.

The figures emerging from the Milestone Reports were put alongside alternative ways of calculating the \$ benefits from the program, reinforcing the conservative nature of the estimations and confirming that the 'true' result lay in the order of the targeted annual gain of \$280 Million across all industries – and was probably in excess of this. As pointed out above, the full annual financial benefits from the initiative are yet to be realised.

## Influence of RWUEI Activities on Changes Reported

Survey respondents were asked to indicate how much they attributed the RWUEI activities and information to their decision to make practice changes.

The table below groups the ratings into four categories, not at all (1), a little (2, 3 & 4), a moderate amount (5, 6 & 7) and a lot (8, 9 & 10). Overall, 55% of respondents attribute the influence of RWUEI program activities or information on their decision and ability to make changes by a *moderate amount* to a *lot*.

Main Income	Not at all	A little	A moderate amount	A lot	Total Respondents	Average Score
Sugar	15%	31%	31%	23%	52	4.8
Cotton / Grains	21%	34%	34%	10%	29	4.3
Lucerne	25%	8%	50%	17%	12	4.8
Dairy	12%	16%	40%	32%	25	5.9
Horticulture	29%	26%	20%	26%	35	4.4
Other	29%	0%	29%	43%	7	5.4
<b>Total</b>	<b>20%</b>	<b>25%</b>	<b>32%</b>	<b>23%</b>	<b>160</b>	<b>4.8</b>

Eight percent of respondents attributed the RWUEI activities as having had some level of influence on their decision making and ability to act to improve water use efficiency. The average scores were mostly below 5 even though the majority of the respondents gave ratings over 5 ('a moderate amount' plus 'a lot'). This was due to the 20% of respondents giving a rating of 1 ('not at all') that heavily weights the average downwards.

As pointed out earlier, survey respondents were also asked to indicate how much program activities and how much the Financial Incentive Scheme impacted on their decision to make changes. 86% of respondents attributed the influence of the subsidy to making the changes by a *moderate amount* to a *lot*. This reflected this strong linkage and synergies between the extension and incentive program.

The analysis strongly indicates that the overall program was the major driver in stimulating and facilitating changes to improve on-farm water use efficiency in the irrigation industry in Queensland over the life of the project.

## Impact and Influence of Other Measures and Programs on the RWUEI

As pointed out in the Synergy Analysis of the program (Coutts 2002), improvements in water use efficiency on farms can be approached through:

1. *Legislation/water controls* – forced change
2. *Financial incentives* – encouraged change
3. *Education and extension* – voluntary change

The RWUEI is primarily concerned with education (research), and extension (and financial incentives). In terms of legislation, it was explained that the Queensland government initiatives in the area of water resource planning, allocation and management processes fall within the context of the COAG (Council of Australian Governments) Water Reform Agenda. These approaches are being extended to all major river catchments and include: Water Resource Plans (WRPs) – developed through the water Resource Planning Process and Resources Operations Plans (ROPs). These involve community and industry consultation and will be used for managing the allocation and use of water.

The Strategic Directions 2001 (Queensland Government, Department of State Development) paper defined key issues to be addressed for sustainable water development as:

- *Implementation of the water reform program through WRPs and ROPs;*
- *Provision of information to assist industry and water service providers to assess identified resource development, water use efficiency and trading opportunities; and*
- *Responding to specific regional and industry development requirements (p92).*

The analysis demonstrated that RWUEI Adoption Program had a distinct niche in the overall goal of improving rural water use efficiency in Queensland – ***that of directly working with irrigators across the major irrigation industries to improve on-farm water use efficiency.***

It concluded that although agencies such as the DPI, EPA and DNR&M and industry organisations BSES, QFVG and Cotton Australia provide some education and support to irrigators, they do not have significant human resources devoted to make a concerted effort for change at an on-farm level outside of that funded through the RWUEI. The infusion of a critical mass of human resources across the key industries is the major contribution of the project. As the Sugar RWUEI Adoption Program Coordinator put it...*although WUE is extremely important in the sugar industry, there are extreme financial and environmental pressures on the cane industry...and there is little scope for the industry to justify maintaining funding at anything like current levels without government support. If the RWUEI project was not in place, the resources to achieve this outcome would be greatly reduced and the outcomes achieved much reduced.*

The RWUEI Adoption Program dealt with issues within the farm boundaries, complementing efficiency improvements that might occur in the storage, allocation and distribution systems. Sunwater, for example, is the government corporation which owns and operates 27 water storage and distribution systems. Eight involve channel and pipeline systems where WUE is most important. As a water service provider, they have no direct role in terms of on-farm operations. Their emphasis is on reducing water loss prior to delivery on-farm, rather than on-farm efficiency itself.

RWUEI along with SunWater carried out a study on delivery efficiency of SunWater managed schemes. Reports published for each irrigation scheme has provided recommendations to implement in order to improve the delivery efficiency of the distribution systems.

The new water trading policies are unlikely to yet have had an impact in water usage changes on farms – however, as these changes may impact on the way irrigators view and value changes in the future they may stimulate further on-farm water use efficiency improvements.

The Synergy Analysis highlighted the RWUEI Adoption Program as being the significant contributor to the following processes:

- ▶ Recognition incentives (Awards Schemes);
- ▶ Developing awareness of the need for WUE;
- ▶ Education of irrigators about improving WUE;
- ▶ Developing on-farm benchmarks for assessing improvements;
- ▶ Measuring and assessing on-farm systems; and
- ▶ Local trials/demonstrations of improved irrigation systems.

Survey recipients were asked to nominate how much their decision to make changes was influenced by RWUEI activities and information.

## Other Factors Influencing Outcomes

### Climate

It is clear that climate was a significant factor impacting on water use efficiency in a number of industries and regions across the state.

Drought conditions limit irrigation water available and, according to the Cotton and Grains Coordinator, this means that water that is available is used to keep the crop alive rather than being used strategically and efficiently. This was given as a key reason to explain water efficiency indicators going backwards in the final year of the initiative in cotton.

The Sugar Industry referred to the severe drought affecting the Bundaberg/Isis district during the 2001/02 year. A slight shortfall in productivity improvement in 2003 was attributed to...*extremely dry weather conditions and inadequate irrigation water available causing crops to die or yield extremely poorly.*

The 2003 Dairy Milestone Report said that...*if there has been any reason for the program not influencing more irrigators in the adoption of BMP, it has been the climatic conditions and subsequent financial restrictions (p.13).* The drought was considered to be an overriding factor within the Rural Water Use Efficiency Initiative - "Water for Profit". It was stated that...*the success of the RWUE project state-wide is continuing despite the worst recorded weather conditions being experienced and that most river/stream and aquifer systems closed to irrigation, and extensive state-wide imposed water restrictions.* It was pointed out that...*normal farm operations have been severely hampered due to the drought and irrigation is being used more strategically. Farmers have been acknowledging that efficiency and Best Management Practices (BMP) are significant issues...but survival of life on the farm is taking all the financial resources left to them. Irrigation improvement is taking a second place to bread and butter on the table.*

The 2003 Fruit & Vegetable Milestone Report also referred to...*severe drought conditions during the last year or so of the initiative...and Drought conditions during recent times have placed a greater emphasis on irrigation efficiency, but at the same time, many growers have had reduced production and income, so have not been able to make changes.*

## Markets and Deregulation

The deregulation of the dairy industry has had a significant impact on the overall water use of the industry in the final year. It was noted in the 2003 Dairy Milestone Report that there was a base of 1600 dairy farms in 1999 which dropped to only 1120 in March 2003 as a result of deregulation and drought. It was estimated that the dairy industry would therefore reduce its water requirements by approximately 28% of 216,000 ML for irrigation. [This had minimum impact on the reported impact of practice change in the Dairy Milestone Report as estimates were made on a proportionate basis and adjustments were made for changes to farm numbers. Many dairy farmers also received a price drop of 3 cents/litre which some calculated as a loss of \$18000/year. This would have impacted on the ability of some farmers to purchase new equipment to improve irrigation.

It was noted that the Lucerne Industry is completely deregulated and unorganised, and the resultant competition limited the effectiveness of...*modern extension methods because of growers' reluctance to share experiences.*

An overall impact to the horticultural industry has been the increase in the size of the industry over the period of the initiative. *Horticulture has gone from an \$850 million dollar industry (Barraclough, 1999) at the start of the program to over \$1.2 billion industry (DPI estimate) for the 2002/2003 year. This was during the period that the RWUE Initiative has made a positive contribution to productivity gains and irrigation efficiency.*

Also it was noted that...*wide variations in prices and uncertainty of the security of water in some regions have also been quoted by some growers as impediments to make changes, even if they wish to do so.* It has been suggested that the fixed component of water charges of regulated water discourages irrigators to be efficient. The 2003 Sugar Milestone Report stated that the threat of regulatory change to the industry in recent years as well as the sugar package has made it difficult to focus the industry's attention (on water efficiency) during the final period of the Initiative.

## Disease

Orange Rust was reported by the Sugar Industry to have had a major impact on cane yields in recent years – although it was pointed out that this impact has been reduced in the last year as a result of the use of less susceptible varieties. The Cane Water Index – the major indicator of relative water use efficiency – was adjusted for this factor.

## Benefit/Cost Analysis

This cost-benefit analysis is indicative only. The level of hard quantitative data in terms of outcomes does not lend itself to in-depth economic analysis. Likewise, establishing clear, indisputable links between dollars invested and dollar benefits is difficult.

Dollar values are taken at face value and adjustments are not made for Net Present Values of costs and benefits. Also, no attempt is made to cost out in-kind inputs from irrigators, industry, government agencies and other parties.

For the purpose of this report, the quantitative analysis in this section has calculated Benefit Cost Ratios (BCRs) based on the direct dollar values of the funding provided to industry by NR&M, the direct dollar value of complimentary investment by industry and the estimated overall direct dollar benefits to the industries in terms of potential increased productivity.

Two BCR calculations are presented. The first assumes that the costs are only the funding from Government – which is more of an indication of how effective targeted Government funds have been in bringing about or accelerating substantial improvements in the State's irrigated agriculture industries. This is the basis adopted by Barraclough and hence provides a BCR which is comparable with figures derived in that report.

The second is a truer assessment of the BCR in that all direct costs (Govt subsidy plus industry and grower funds) are included.

Both approaches show a positive impact of the expenditure under the Initiative.

Qualitative or less tangible costs and benefits including better information and education about irrigation practices, lowered environmental impacts, co-ordination across irrigation sectors and job creation are also discussed in the section.

## Direct Dollar Values

### Direct funds from NRM

According to Barraclough & Co, the total initiative was to be funded over 4 years at \$41 Million dollars. \$23 Million was planned to be spent on the Industry Adoption Programs (extension, development and research). The remaining \$18 Million was allocated to the initiative's three remaining elements: *Reducing Water Losses from Storages from Farms*; *Financial incentives to achieve Best Irrigation Water Management*; and *Reducing Losses in Irrigation Water Supply and Distribution Systems*. The Ministerial reply to the question on notice stated that to the 3<sup>rd</sup> March 2003, the Government to date had contributed \$10.5 million, to the FIS element of the RWUEI.

This evaluation is concerned with the Industry Adoption Programs (including the associated R&D Projects) and the supporting Financial Incentive Scheme.

RWUEI Element	\$Million/ 4 year project life
Adoption Program (allocated over 4 years)	23
FIS (to March 3 <sup>rd</sup> 2003)	10.5
<b>TOTAL</b>	<b>33.5</b>

It is recognised that the actual figures spent over the period may vary a little from this – and that funds were fed into the program over the four year time period having changing Net Present Values.

### Direct investment by Industry (grower and industry body costs)

#### Investment under the RWUEI

The principal investment in the RWUEI by irrigators was through participation in the Financial Incentive Scheme. The May 31 2003 report on the Financial Incentive Scheme reported that irrigators had provided a further \$31.4 Million into improving irrigation efficiency.

Not all of the data is available for the total industry input but, as noted below for Dairy and Lucerne Industries, in the order of \$500,000 was reported as originating from industry and other bodies. If this were indicative across all industries, it would add a further \$2 million dollars as industry input.

In this case total industry costs would be in the order of:

$$2+31.4 = \$33.4M.$$

### Estimated Investment Influenced by the RWUEI

Adding the government contribution and the direct investment by Industry, gives a total known investment under the FIS of: \$33.4M+\$10.5M =\$43.9M. While a significant number of respondents to the survey indicated they had made changes without FIS assistance, it has not been possible to record the magnitude of these changes and all of the investment involved through the Initiative. However, the irrigator survey offers an avenue for estimating the funds invested by growers outside of the Financial Incentive Scheme (and outside of the Initiative).

Based on the survey responses and FIS application numbers (55% said they were influenced by a *moderate* amount to a *lot* and 52% said they had applied for FIS assistance with 98% of FIS applicants received funding - ie 98%x52%=51% receiving funding) the maximum investment by irrigators under the RWUEI could be assumed as:

$$(55\%-51\%)/(51\%) \times 43.9 + 33.4 = \mathbf{\$36.8M}$$

### Estimated investment not influenced by the RWUEI

As discussed above for investments influenced by the Initiative but made outside of FIS funding, the survey responses could also be used to estimate investments made but **not** (or little) influenced by the RWUEI.

Based on the survey responses - 87% said they had made changes but only 55% attributed their actions to the RWUEI (ie influence *moderate* to a *lot*). The maximum investment by those irrigators claiming to not have been influenced by the RWUEI could be estimated as:

$$(87\%-55\%)/(51\%) \times 43.9 = \mathbf{\$27.6M}$$

### Estimated overall direct dollar benefits to Irrigation Industries

The following table shows the estimated benefits to irrigation industries as a result of annual water use efficiency gains through the RWUEI program based on the Milestone Report calculations.

Industry	\$Million/year
Sugar	9.7
Cotton & Irrigated Grains	57
Fruit & Vegetables	113.3
Dairy & Lucerne	17.7
<b>Total</b>	<b>197.7</b>

The estimated (conservative) economic benefit in a *single year* across all industries was \$M197.7/yr.

The estimated industry financial benefits from the RWUEI are a statement of what on-going expected annual dollar benefits could be expected *from the end of the four years life of the project* into the future.

As discussed earlier, the measured gains are very conservative because they were based on time periods prior to the completion of the project and don't account for the expected peak of benefits beyond the 4 year life of the project (this will be further fuelled by the follow-up phase to the initial 4 year period).

It should be noted that gains were also achieved incrementally over the four year life of the initiative ***and it could be well argued that the gains achieved by the end of the project more than covered the direct dollar inputs into the initiative.***

### Benefit/Cost Analysis

The Barraclough report gave a State target for benefits to the industries from the RWUEI as \$280 million (in a year) from a Government investment of \$23 million in the adoption program – or 280/23, or **12:1**. It should be noted that this calculation uses only the adoption program costs.

A more realistic assessment would include the financial incentives scheme (ie all the funding under the initiative - \$41M) and result in a BCR of 280/41= **6.8:1**

The initial Benefit/Cost Ratios calculated in this report are based on expenditure over the life of the RWUEI. They do not include costs and returns occurring into the future and hence *have not been adjusted for Net Present Value*. In-kind contributions have also not been costed. Likewise, it is assumed that the total benefits were a result of the project activities (it has been argued earlier that the RWUEI was the major influence).

### Benefits/Government Costs

Given that the total Government inputs into the Adoption/FIS program over the four years was in the order of \$33.5 million, the following *simple* Benefit/Cost Ratio if only the (direct agency) cost of the project was put against the potential (direct dollar industry) benefits **in the first year** post the 4 year initiative would be as follows:

***Total direct dollar benefits across irrigation industries in the first year post-initiative/Total direct agency cost over the four years***

$$\$197.7M/\$33.5M = 6:1$$

### Benefit/Government and Industry Costs under FIS

Total costs to industry and government have been assessed above as (\$33.4M + \$35.5M) = \$66.9M. The *simple* Benefit/Cost Ratio based on the first year of benefit then would be in the order of:

$$\$197.7M/\$66.9 = 3:1.$$

As discussed above, an estimate of irrigator investment based on responses to the survey indicates that only another \$2.78 million dollars could be added to the industry costs spent as a result of the RWUEI making little change to the BCR calculated above of approximately 3:1.

### Benefit/Government and Industry Costs under and outside the RWUEI

Finally, the least favourable estimate of a *simple* Benefit/Cost Ratio for the Initiative assumes the estimated gains were not totally attributable to the RWUEI. As discussed above, an estimate of irrigator investment based on responses to the Survey indicates that possibly another \$27.6 million dollars may have been invested and contributed to the overall benefit. If this were the case the resultant calculation for a Benefit/Cost ratio would be :

$$\$197.7M/(\$66.9M+ \$27.6M) = 2.1:1$$

This is a pessimistic estimate of the BCR of the dollars invested, however it remains a very favourable outcome.

### Assumptions/issues

There are a number of assumptions and premises in these *simple* Benefit/Cost Ratio calculations that would affect the result. These include:

- Only one year's worth of benefits have been used;
- That the calculations which link improvements in ML to productivity and product value have validity;
- That the extrapolations used to estimate ML across whole industries are robust;
- Only the direct cost inputs are considered – direct and in-kind costs from the industries and irrigators are not considered; and
- Benefits beyond the industry and down the marketing chain are not included.

More details on the rationale behind the approach used in this Benefit/Cost Ratio Analysis are included in Appendix I.

To some extent it is only speculation as to the length and level of the curve of accrued benefits to irrigation industries. If an assumption was made that comparative benefits were maintained at the same rate beyond those that would have otherwise occurred over time for a period of 4 years (*momentum equal to the length of the project*), the simple benefit/cost ratios calculated above would improve by four-fold, for example:

$$197.7 \times 4 / 33.5 = \mathbf{23.6:1}$$

Even if the accrued benefits were discounted to better match the value of the input dollars, the order of magnitude would be similar.

### Effectiveness of Financial Incentive Scheme

It was stated in the Ministerial reply concerning the Financial Incentive Scheme that to the 3<sup>rd</sup> March 2003...*the Government to date has contributed \$10.5 million, to the FIS element of the RWUEI with matching investment from landholders being \$31.42 million. For every one dollar Government has invested, the return has been three dollars from landholders. This figure is as at 3<sup>rd</sup> March 2003, and the figure is subject to increase by 30<sup>th</sup> June 2003, as all approved applications have not been paid as at 3<sup>rd</sup> March 2003.*

From these figures, the \$31.42 Million matching funds from landholders can be seen as a cost (extra dollars needed to be invested to obtain the industry return) or a benefit (the \$10.5 million stimulated a further \$31.42 Million to be invested in improving water use efficiency). It has been argued that this is a cost in deriving the reported benefits from the Initiative and that the fact that government was able to leverage or encourage that investment is separate to the estimated/potential financial benefits of the program (Cuerel 2003 pers com).

### Matching funds from industries

Some Milestone Reports pointed out that that their industries provided funding to add value to that provided by NR&M. Funds have been provided to extend the locations or treatments of trials or to add value to existing trials. The extent of this funding is not clear, however, its treatment in calculating the Benefit/Cost Ratios of the RWUEI would be similar to that of the matching funds from the FIS.

As an example, the Dairy and Lucerne 2003 Milestone Report noted that funding came from the following sources:

- \$2,032,109 from NR&M
- \$435,000 from DPI
- \$100,000 from third parties

## Other Costs and Benefits

### Costs

As pointed out above, in-kind costs from agencies, industries and irrigators have not been considered in the simple benefit/cost calculation. This could be quite significant given the high level of participation in the initiative across the industries.

Another 'cost' could be the raised expectation that governments would/should intervene (with public resources) to assist in providing advice and monetary incentives for individual irrigation businesses to become more efficient and profitable.

### Benefits

A key benefit presumed by this Initiative was reducing the need for building further dams to provide irrigation water to farms. The logic was that the 180,000 ML saved per year through more efficient on-farm use would mean that new dam capacity of that order was not needed nor the infrastructure to support and supply the extra water to farms. Losses in distribution would also be avoided. Also, associated environmental and cultural damage that may have resulted from building this extra dam capacity would not occur. It has been pointed out that for a dam to have a yield of 180,000ML does not mean that the capacity has to be 180,000ML as factors like expected reliability, mean annual flow evaporation and seepage losses, average depth of water in the dam, delivery efficiency of the system etc would determine the required size. Generally speaking, the capacity of the dam could be several times the required 180,000ML (Rajakaruna J 2003 Pers Com).

More efficient use of on-farm water was also expected to yield direct environmental benefits in terms of...*reduced run off and drainage of pesticides, salts and nutrients into rivers, aquifers and streams*. This benefit was raised by the reports and through the trials although there was little direct measuring or estimating of the degree of these benefits.

When the R&D projects were reviewed in the 2003 workshop, it was pointed out that much of the infrastructure and tools purchased for the trials would have on-going benefits in research and monitoring well beyond the life of the project. The data sets generated through the R&D projects is also an enduring benefit.

Similarly, the knowledge and information products generated through the R&D projects has the potential to continue to provide on-going learning and information support to irrigators and their advisors beyond the life of the original initiative. Such information has been made available via CDs, web-sites and print media.

A major benefit is also the increased human capacity in terms of understanding of irrigation technology and management within irrigators and service providers. The large number of people who have been engaged in the initiative over the four years of the program and the high participation levels means that there is a critical mass of people who have the potential for continuous improvement in irrigation efficiency.

The increased interaction between industries could also expect to yield further benefits in cooperative activities.

### Jobs

Based on the reported improvements in water use efficiency and using the relationship between ML and jobs that formed the basis of the proposed outcomes of the initiatives, the following gains in job numbers can be estimated. As in the earlier table, jobs relate to on-farm, processing and support industries sectors.

The multipliers were developed through a number of referenced sources (see Appendix G) and were not directly calculated for sugar, cotton or lucerne. The basis for the multiplier has not been investigated by the evaluator and is used because it was the basis for the original estimates and so better compares ‘apples with apples’.

Industry	1000's ML gained/year	Jobs/1000 ML	Total Jobs
Sugar	30.275	2.75*	83
Cotton & Grains	67.855	2.75	187
Horticulture	11.073	30	332
Dairy & Lucerne	30.580 12.600	15 2.75	459 34
<b>Total</b>	<b>152.383</b>		<b>1095</b>

\*based on ‘cropping’ figure – may not be totally applicable to sugar

This is in the order of the 1600 new jobs for regional Queensland as forecast with the project – but is an imputed amount rather than an actual figure. The impacts of the drought and deregulation may also impact on the actual figures. Certainly the demand for new equipment through the FIS would have had a significant flow-on to the irrigation service industries in terms of dollar benefit and jobs.