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Rural water use efficiency, a major key to increase production and reduce the burden on our valuable water resource

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Abstract

The "Dairy and Lucerne (Alfalfa) Adoption Program" of the Queensland Rural Water Use Efficiency Initiative (RWUEI) is targeting five major dairy and three major lucerne irrigation regions in the state with the objective to develop better irrigation water use efficiency (WUE) through the adoption of best management practices in irrigation. The major beneficiaries of the program will be industries, irrigators and local communities.

The benefits will flow via two avenues: increased production and profit resulting from improved WUE and improved environmental health. As a added result, the work is likely to contribute to an improved public image of the dairy and lucerne industries.

In each of the regions, WUE officers have established grower groups to assist in providing local input into the specific objectives of extension and demonstration activities. The groups also assist in developing grower's perceptions of ownership of the work. Extension activities are based around on-farm demonstration sites in each region where irrigation management techniques and hardware are showcased.

A key theme of the program is monitoring and scheduling of water use. Due to vast distances covered by the project this has meant introducing new remote monitoring technologies to farmers. This is applied both to on-farm storage, pumping and distribution as well as to application methods and in-field management.

1 Introduction

Australia is a nation of vast extremes.

Australia is the driest inhabited continent even though some areas have annual rainfall of over 1200 millimetres. Our climate is highly variable-across the continent generally, as well as from year-to-year [6]. As such there is an ever-increasing need to enhance our water resource programs as our population grows. *Australia harvests, 'utilises', 5% of its surface water. Our irrigated agriculture uses approximately 70 to 80 percent of this resource [8].*

The dairy and lucerne industries account for approximately 10% of this use nationally (4% dairy, 6% lucerne) [7]. Hood [9] described WUE, in irrigated agriculture, as maximising the returns and minimising the environmental impacts for every megalitre of water used for irrigation purposes.

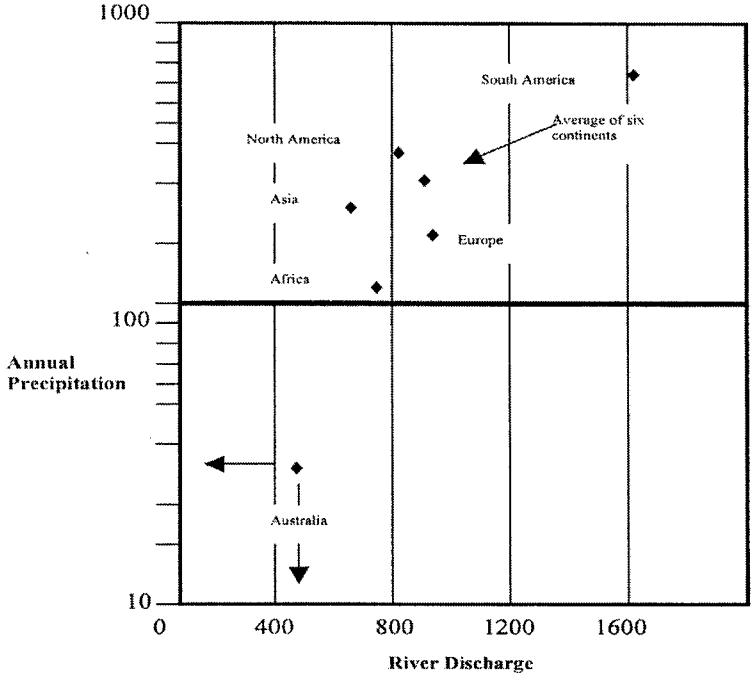

Figure 1: River discharge by continent (excluding Antarctica) related to rainfall supply, adapted from [5].

Figure 1 above shows the annual average river discharge in millimetres over annual precipitation in millimetres over continental area.

In 1999 the Queensland Government introduced a four-year program, the Rural Water Use Efficiency Initiative (RWUEI) [4].

Queensland Department of Primary Industries (DPI) Agency for Food and Fibre Sciences' Intensive Livestock and Sheep Institute, is undertaking the

"Dairy and Lucerne Adoption Program" within the irrigated dairy and lucerne industries. The program is being conducted as part of the RWUEI in partnership with the Department of Natural Resources and Mines (NR&M). 'Irrigation for Profit' is the localised team name for the dairy and lucerne adoption program.

The objective of this adoption program is to help Queensland dairy and lucerne irrigators measure, record and monitor their progress in WUE improvement, thus aiming to increasing, irrigation efficiency by at least 11%, with 40% of growers adopting Best Management Practice (BMP) for irrigation by June 2003.

The Program has industry ownership through and is administered by Queensland Dairyfarmers Organisation (QDO) in Brisbane. It is being supervised by and takes direction from a consultative committee, which includes all major stakeholders. Similar programs are also being conducted in the cotton and grains, sugar, and the fruit and vegetable industries in Queensland.

2 Methods

Five major dairy and three lucerne irrigation regions in the state are being targeted. These extend from Atherton in North Queensland, Beaudesert in the southeast Queensland, St George in the west of Queensland and Texas on the Queensland and New South Wales border.

In each region, WUE officers have established grower groups to assist in providing local input into the specific objectives of extension and demonstration activities. The groups also assist in developing growers' perceptions of ownership of the work. Activities are based around at least six and up to twelve on-farm demonstration sites in each region, where irrigation management techniques and hardware are showcased. A key theme of the program is monitoring water use. This is applied both to distribution as well as to application methods and in-field management.

Thus the WUE officers are conducting an education program for growers which includes:

- Establishing an annual award system which provides incentives and opportunities to improve WUE and which recognises individual farmer achievements or initiatives that have led to improved WUE.
- Developing, demonstrating and promoting the implementation of the water monitoring systems on farm using simple practical methods and devices, in remote areas utilising remote telemetry (both digital and analogue/CDMA)
- Developing an awareness of water management issues.
- Conducting benchmarking surveys at strategic times during the project to evaluate performance and outcomes.

To address some of the many issues confronting irrigators, 42 demonstration or trial (benchmarking) sites were established during 2001/2002. Irrigated crops and pastures involved were: maize, oats, barley, sorghum, lucerne, rye grass, clover mixes, kikuyu and other tropical grass pasture mixes. Irrigation systems included, centre pivot, subsurface drip, side-roll sprays, lateral move, travelling

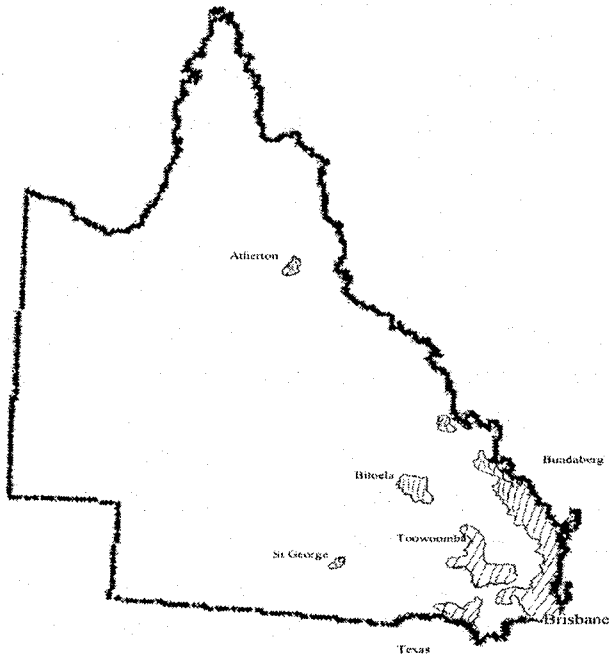

Figure 2: Shaded areas indicate the main irrigated dairy and lucerne areas of Queensland.

gun and hand shift systems. In addition, trials were established to investigate the control of seepage deep-water movement caused by over irrigation. The program team carried out similar activities in previous years.

A Financial Incentives Scheme (FIS) that partly reimburses growers for their outlays is assisting the implementation of the adoption of new irrigation technologies. This scheme (with farmer inputs) invested $7M into dairy and lucerne irrigation infrastructure within its first two years of operation. This has aided rapid change in increased efficiencies WUE.

3 Progress and discussion

Because of the program, an increasing number of irrigators are now achieving irrigation efficiencies well in advance of the State benchmarks presented in stocktake reports [2,3], which was compiled in the early stages of the program. These efficiency gains indicate that the 11% target increase in efficiency set for the program is being achieved and in many cases exceeded.

Up to December 2002 the project has had 75% participation of irrigators in extension activities including field days, workshops and farm visits, 27% who have had their irrigation systems audited for Distribution Uniformity (DU), pumping costs ($/ML) and application rate, and 51% who have used the FIS to make improvements to their irrigation efficiency.

The greatest opportunity for water saving is with measurement. Through measurement, the trial site co-operators have investigated various management options and set targets for improvement. Irrigation scheduling tools are also now being well utilised to effectively time irrigations, but they are yet to be used to their full potential. If these tools are correctly calibrated they can be used to show the irrigator how much water needs to be applied in each irrigation.

Through demonstration sites and research trials the industry has established benchmarks for agronomic water use efficiency. The following table shows the data collected from demonstration sites over a winter growing season compared to the Barraclough stocktake figures.

Table 1: Current trends against the Barraclough dairy benchmarks [2].

	Production/ ha	Irrigation	Rainfall	Litres/ML	$/ML
2002	7810 litres	2.96ML	1.5ML	1751l/ML	$542/ML
1997	6515 litres	3.75ML	1.5ML	1240l/ML	$384/ML

The above table demonstrates a 30% increase in the economic water use index. We have used $0.31 as the price for a litre of milk in both calculations. In 1997 farmers were being paid $0.58 for their quota milk (averaged 50% of production) and $0.31 for manufactured milk. In 2002 they are being paid $0.31 for all their milk. Although the last litre cost remains the same for calculating economic efficiency, in absolute terms their incomes have decreased significantly (25 to 30%) and their profit margins drastically. It is important to note that the Queensland dairy industry went through deregulation during these years and this had a major influence on dollars returned.

Across the industry we have used a triangulation method to establish water use efficiency gains. A survey was conducted of 500 farmers who had made changes on their farm directly as a result of the "Irrigation for Profit project". The results show an increased production of 5.3% while using 3.4% less water. This equates to an 8.7% improvement (Approximately $7M AU) in water use efficiency across the dairy and lucerne industry in 2002.

The following case studies highlights the importance of measurement:

- Changing a traditional farming practice of applying 120mm of irrigation before planting ryegrass. The use of a scheduling tool was able to show that only 30mm was required to fill the profile, saving 0.9ML per hectare in one irrigation event. This farmer has also reduced his traditional 65mm irrigation application to 25mm, allowing him to take advantage of small rainfall events. Irrigation water use has been halved in a relatively dry year.
- A farmer using a travelling irrigator has changed from applying 45mm every 21 days to 30mm as indicated by an EnviroSCAN®. They have also changed from a ring to a tapered nozzle to improve distribution uniformity. Production has increased by 20% using the same amount of water. The majority of deep drainage has been eliminated.

- Most solid set irrigation systems in Queensland have been installed with a single jet nozzle. The Irrigation for Profit team has identified the opportunity to improve distribution uniformity (DU) on most solid set systems by installing a back jet (and modifying the front jet if required). One example improved DU% from 60% to 75%. This meant that 15% less water needed to be used to apply the same evenness of application.
- Many farms with centre pivots have not been replacing nozzles with the correct size. One farm was able to increase DU% from 70% to 85% by installing the correct nozzles. Most centre pivot owners are now aware of this issue.
- With planning assistance from the 'Irrigation for Profit' project the first centre pivot has been installed in the Wide Bay dairy industry. The labour requirement has been reduced significantly and initial production measurements are very positive (2000 kg DM/ha increase).
- Through a consistent awareness campaign most farmers now aim to apply between 20 and 30mm per application to ryegrass. Five years ago it was common for farmers to aim to apply up to 75mm. Actual measurement with catch cans is showing that a perceived 25mm (based on advice at installation) is actually varying from 20mm to 50mm. Many farmers have changed their irrigation application based on actual measurement as opposed to a design specification.

4 Some highlights to date

The program is achieving very significant outcomes towards the better management of irrigation water in both the dairy and lucerne industries. These include:

- Awareness and participation in the program exceeded 75% of irrigators
- A survey conducted in May 2002 indicated that 68% of dairy and lucerne irrigators had become involved in best management practices.
- An increasing number of irrigators are now achieving irrigation efficiencies well in advance of the State benchmarks determined at the commencement of the program.
- Results indicate a gradual improvement in water use across the state. The management practices that have resulted in these trends represent real and practical opportunities for growers to improve their WUE.

5 Program evaluation

The economic, environmental and social benefits of the program are being monitored. The impact of the program is to be evaluated in relation to its influence on improvement in WUE, irrigators' movement to BMP, and their awareness of and participation in the program.

An independent evaluator carried out a mid-term evaluation of the program's performance in September 2001 and a final evaluation will be made on completion of the Program [1].

The mid-term evaluation:

- reported outcomes against agreed measures and targets
- reviewed the effectiveness and rigour of the data collection processes
- reported on suitability of the measures used to evaluate performance
- recommended changes to the evaluation plans
- recommended any necessary changes to the Adoption Program
- highlighted areas where performance has been exceptional and indicated actions that could flow from these success areas
- identified poor performance areas and suggested actions to correct or cease these activities

At the final evaluation the evaluator will:

- report outcomes and outputs against agreed measures and targets
- report on accuracy of the data
- using the data accumulated, undertake a benefit/cost analysis of the program
- report on reasons for successes and failures
- provide recommendations for future actions to improve performance in WUE

6 Conclusions

Irrigators are now becoming increasingly conscious of the relationship between their industry's economic sustainability and its impact on the environment. Best Management Practices are being developed and applied.

The program team is encouraging irrigators to focus on the precision of their application of water. Many are now using scheduling tools to determine when and how much water to apply and so deliver to the root zone exactly what the crop requires. There is also now an increased use of water meters. These tools assist in minimising or eliminating runoff from the fields and drainage losses beyond the root zone, thus preventing the development of salinity.

Although the program has been in place only since 1999 the dairy and lucerne adoption program team is making real progress in influencing irrigators to become more aware of their water use and assisting them in making those management changes, which will enhance irrigation efficiency.

Irrigators in both the dairy and lucerne industries are now highly motivated to proceed with management changes, that have been identified by the Program, which will increase irrigation efficiency, but they need continued guidance and assistance to maintain this motivation and implement their new management goals. Funds are currently being sought to take the program beyond June 2003 so that irrigators can be assisted in their continued efforts to improve irrigation efficiency and water management.

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