Engagement and Impact 2018

University of Southern Queensland

USQ07 (HLS) - Impact

Overview

Title

(Title of the impact study)

Optimising surface irrigation leads to increased productivity in the Australian cotton industry

Unit of Assessment

07 - Agricultural and Veterinary Sciences

Additional FoR codes

(Identify up to two additional two-digit FoRs that relate to the overall content of the impact study.)

09 - Engineering

Socio-Economic Objective (SEO) Codes

(Choose from the list of two-digit SEO codes that are relevant to the impact study.)

82 - Plant Production and Plant Primary Products
96 - Environment

Australian and New Zealand Standard Industrial Classification (ANZSIC) Codes

(Choose from the list of two-digit ANZSIC codes that are relevant to the impact study.)

01 - Agriculture
28 - Water Supply, Sewerage and Drainage Services
05 - Agriculture, Forestry and Fishing Support Services

Keywords

(List up to 10 keywords related to the impact described in Part A.)

furrow irrigation

surface irrigation

water use efficiency

productivity

farming

cotton

optimisation

hydraulic models

remote communities

regional economic development

Sensitivities

Commercially sensitive

No

Culturally sensitive

No

Sensitivities description

(Please describe any sensitivities in relation to the impact study that need to be considered, including any particular instructions for ARC staff or assessors, or for the impact study to be made publicly available after EI 2018.)

Aboriginal and Torres Strait Islander research flag

(Is this impact study associated with Aboriginal and Torres Strait Islander content?
NOTE - institutions may identify impact studies where the impact, associated research and/or approach to impact relates to Aboriginal and Torres Strait Islander peoples, nations, communities, language, place, culture and knowledges and/or is undertaken with Aboriginal and Torres Strait Islander peoples, nations, and/or communities.)

No

Science and Research Priorities

(Does this impact study fall within one or more of the Science and Research Priorities?)

Yes

Science and Research Priority	Practical Research Challenge
Soil and water	New and integrated national observing systems, technologies and modelling frameworks across the soil-atmosphere-water-marine systems.

Impact

Summary of the impact

(Briefly describe the specific impact in simple, clear English. This will enable the general community to understand the impact of the research.)

Researchers at the University of Southern Queensland (USQ) were responsible for the development and implementation of IrriMATE (R) technology which has led to significant savings for one of Australia's largest rural export earners, the cotton industry.

The technologies pioneered by USQ researchers have enabled cotton growers to measure the water balance on an irrigated agricultural operation and use that data to realise greater water productivity.

The average farmer utilising the technologies can generate $83,000/year extra profit. From 2011-2016, the implementation of the irrigation technology has contributed to the conservation of over 170GL water, equivalent to 68,000 Olympic swimming pools, and an economic benefit of over $198m.

Beneficiaries

(List up to 10 beneficiaries related to the impact study)

Queensland cotton farmers

Queensland Government

New South Wales cotton farmers

New South Wales Government

Cotton farming communities in regional Queensland and New South Wales

Australia crop consultants

Australia cotton shippers

Australian cotton ginners

Murray Darling environment

Countries in which the impact occurred

Australia

Details of the impact

(Provide a narrative that clearly outlines the research impact. The narrative should explain the relationship between the associated research and the impact. It should also identify the contribution the research has made beyond academia, including:
- who or what has benefitted from the results of the research (this should identify relevant research end-users, or beneficiaries from industry, the community, government, wider public etc.)
- the nature or type of impact and how the research made a social, economic, cultural, and/or environmental impact
- the extent of the impact (with specific references to appropriate evidence, such as cost-benefit-analysis, quantity of those affected, reported benefits etc.)
- the dates and time period in which the impact occurred.

NOTE - the narrative must describe only impact that has occurred within the reference period, and must not make aspirational claims.)

Irrigation practices in the Australian cotton industry have benefitted significantly from USQ's irrigation research. USQ identified that major water use efficiencies could be gained in the cotton industry by changing the way irrigation was managed on farms and committed significant resources to work with the industry to develop and implement solutions. Subsequently, IrriMATE (R), a predictive software tool and methodology, was developed by USQ researchers to optimise surface irrigation practices. A cost-benefit analysis of Cotton and Research Development Corporation (CRDC)-funded research conducted by the BDA group in 2007 credited IrriMATE (R) technology as the main driver for greater water productivity in the cotton industry. The report showed that water savings across cotton systems were 28.5GL/yr with a corresponding economic gain of $33m/yr at the time. The 2007 BDA report conservatively predicted future savings based on the on-going adoption of the IrriMATE (R) technology. This equates to 170GL of water a year and $198m in the six year period.

The cotton industry comprises some 1200-1500 cotton farms in New South Wales and Queensland, employing ~10,000 people across the industry. It is one of Australia's largest rural export earners and helps underpin the viability of >152 rural communities. Approximately 91% of Australia's total cotton farms and cotton areas are within the Murray-Darling Basin and in the 2014-15 season 95% of those farms used flood/furrow irrigation (ABARES Murray–Darling Basin Irrigation Survey, 2017 and ABS Water use on Australian farms, 2014–15). Cotton represents 30-60% of the gross value of the total agricultural production in Australian regions (Australian Grown Cotton Sustainability Report, 2014).

Growers use between 5-8ML/ha to irrigate cotton and the cotton industry uses between 1200GL (2014-15) and 2060GL (2011-12) depending on seasonal conditions, which is up to 26% of the annual Australian irrigation total (ABS water use on Australian farms, 2010-11). Before USQ research (pre-2002), surface irrigation practice showed typical irrigation losses of 1.6-2.5ML/ha/yr (Smith, 2005). For an industry comprising 315,000ha of surface irrigated cotton land this represents 500-790GL losses p.a.

Most cotton farms have an abundance of land but are limited to how much they can grow by the water they can access. More efficient use of water means growers can produce more cotton. Water use efficiency is thus paramount in the industry. USQ researchers demonstrated that water savings of up to 15% or 0.15ML/ha/irrigation could be achieved in furrow based systems (used by over 91% of the cotton industry) when irrigators adjusted siphon flow rates and irrigation times (Raine et al 2006, Gillies 2013).

From 1998-2005, the CRDC funded USQ's research resulting in the development and implementation of the IrriMATE (R) technology. IrriMATE (R) significantly benefits the typical cotton farm, which covers 500ha and requires seven irrigations each year. Based on an annual 7ML/ha irrigation and a minimum saving of 1ML/ha/yr, the average farmer is able to realise a 500ML/yr water saving, irrigate an additional 83ha of cotton and generate an extra $83,000/yr profit (based on a typical gross margin of $1000/ha). The gross value of improving furrow irrigation management leading to increased production is worth between $160m and $390m annually to the cotton industry (calculation based on savings of 1 to 2.5ML/ha x 315,000ha x 1 bale/ML x $500/bale). In 2004, USQ licensed the technology to the consultancy group Aquatech Pty Ltd. Working with USQ, Aquatech was positioned to advise farm businesses and deliver the product across Australia.

USQ supported the commercial partnership with Aquatech Pty Ltd over the period 2004-2014, during which time Aquatech and extension/delivery partners undertook >600 farm assessments using IrriMATE (R) hardware and

software. Specific training was given to consultants through to 2014. Ongoing field day/extension programs have continued to reinforce lessons learnt and broaden adoption.

By 2012, 96% of irrigators had improved their furrow irrigation system or changed to an alternate irrigation system and 49% of irrigators had made changes to the flow or size of their siphons (Australian Cotton Sustainability Report, 2014). USQ was the primary irrigation engineering research provider focused on the cotton industry from 2003-2012 and the Australian cotton industry reported a 40% increase in water use productivity in that period (Cotton Australia, 2012). In September 2012, Inovact Consulting reported through the Australian Cotton Industry: Third Environmental Assessment that a 3-4% p.a. increase in water use efficiency was due to grower's uptake of research and development outputs. IrriMATE (R) continued to be the only product of its kind in the industry and the main driver of water savings for farmers (BDA report, 2007). Australian Cotton's 2012 & 2014 reports show that savings were in line with predictions of the BDA report, which credited improvements in the industry to USQ's research, design and implementation of IrriMATE (R). Peak savings for the project were realised for the Australian cotton industry in 2011/2012 and the impact of the research continued across the reference period with cotton farmers using the recommended irrigation practices to efficiently manage their water, leading to increased cotton production.

"USQ has been a pioneer in irrigation research in the cotton industry and it is not just cotton farmers who benefit from an increased yield, it is associated support industries, such as crop consultants, input suppliers, farming contractors, cotton shippers and cotton farming communities." Michael Murray, General Manager, Operations Cotton Australia.

USQ's commercial agreement with Aquatech Pty Ltd concluded in 2014, having achieved its purpose. USQ continues to work with the industry to improve on-farm water management practices.

Associated research

(Briefly describe the research that led to the impact presented for the UoA. The research must meet the definition of research in Section 1.9 of the EI 2018 Submission Guidelines. The description should include details of:
- what was researched
- when the research occurred
- who conducted the research and what is the association with the institution)

Analysis of early (pre-2000) irrigation practices showed irrigation losses of 1.6 to 2.5ML/ha were typical [3] and that significant water savings of up to 15% or 0.15ML/ha/irrigation were achievable when irrigators adjusted siphon flow rates and irrigation times.

USQ researchers, Dalton and Raine [1], evaluated alternative management practices for surface irrigated cotton systems and demonstrated that even simple changes in the irrigation application (e.g. changing the application rate and time) could significantly improve (up to 30%) the efficiency of irrigation applications by reducing tailwater and deep drainage.

This work included rigorous industry evaluation trials and capacity building which led to the development of the IrriMATE (R) hardware and software tools [2]. These tools were delivered to both the cotton industry and more broadly by commercial service providers [8].

Further development of the software tools improved self-calibration of hydrodynamic equations [4], accommodated spatial and temporal variability across fields [5] and industry-wide irrigation performance and water use efficiency benchmarking systems [6,7,10].

Building on the success of IrriMATE (R), USQ researchers are developing and demonstrating smart automated irrigation systems which are showing further benefits [9].

FoR of associated research

(Up to three two-digit FoRs that best describe the associated research)

07 - Agricultural and Veterinary Sciences

09 - Engineering

References (up to 10 references, 350 characters per reference)

(This section should include a list of up to 10 of the most relevant research outputs associated with the impact)

[1] Raine, Steven R. and Dalton P (2003) Final Report: An investigation of in-field irrigation management practices to improve the efficiency of furrow irrigated cotton production systems. NCEA Publication 1000006/1, Toowoomba.

[2] Raine, Steven R. and Purcell, Jim and Schmidt, Erik (2005) Improving whole farm and infield irrigation efficiencies using IrriMATE tools. In: Irrigation Australia 2005: Irrigation Association of Australia National Conference and Exhibition: Restoring the Balance, 17-19 May 2005, Townsville, Australia.

[3] Smith, R. J. and Raine, Steven R. and Minkevich, John (2005) Irrigation application efficiency and deep drainage potential under surface irrigated cotton. Agricultural Water Management, 71 (2). pp. 117-130. ISSN 0378-3774.

[4] Gillies, Malcolm H. and Smith, R. J. (2005) Infiltration parameters from surface irrigation advance and run-off data. Irrigation Science, 24 (1). pp. 25-35. ISSN 0342-7188.

[5] Gillies, Malcolm H. and Smith, R. J. and Raine, Steven R. (2007) Accounting for temporal inflow variation in the inverse solution for infiltration in surface irrigation. Irrigation Science, 25 (2). pp. 87-97. ISSN 0342-7188.

[6] Smith, R. J. and Raine, Steven R. and McCarthy, Alison and Hancock, Nigel (2009) Managing spatial and temporal variability in irrigated agriculture through adaptive control. Australian Journal of Multi-Disciplinary Engineering, 7 (1). pp. 79-90. ISSN 1448-8388.

[7] Smith, R. J. and Gillies, Malcolm H. and Shanahan, Matthew and Campbell, B. and Williamson, Bill (2009) Evaluating the performance of bay irrigation in the GMID. In: Irrigation Australia 2009: Irrigation Australia Irrigation and Drainage Conference: Irrigation Today - Meeting the Challenge, 18-21 Oct 2009, Swan Hill, Victoria.

[8] Roth, Guy and Harris, Graham and Gillies, Malcolm and Montgomery, Janelle and Wigginton, David (2013) Water-use efficiency and productivity trends in Australian irrigated cotton: a review. Crop and Pasture Science, 64 (12). pp. 1033-1048. ISSN 1836-0947.

[9] Koech, R. K. and Smith, R. J. and Gillies, M. H. (2014) A real-time optimisation system for automation of furrow irrigation. Irrigation Science, 32 (4). pp. 319-327. ISSN 0342-7188.

[10] Gillies, M. H. and Smith, R. J. (2015) SISCO: surface irrigation simulation, calibration and optimisation. Irrigation Science, 33 (5). pp. 339-355. ISSN 0342-7188.

Additional impact indicator information

Additional impact indicator information

(Provide information about any indicators not captured above that are relevant to the impact study, for example return on investment, jobs created, improvements in quality of life years (QALYs). Additional indicators should be quantitative in nature and include:
- name of indicator (100 characters)
- data for indicator (200 characters)
- brief description of indicator and how it is calculated (300 characters).)