



Land & Water Australia Project Reference no. COC4

Accelerating adoption of integrated soil management practices in irrigated cotton and grain

Final Report

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Our Co - Investors



1.0 Project Details

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Project Title:

Accelerating adoption of integrated soil management practices in irrigated cotton and grain

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2.0 Executive Summary

The Healthy Soils for Sustainable Farms project “Accelerating adoption of integrated soil management practices in irrigated cotton and grain” rejuvenated soils extension and emphasised the importance of soil health in the irrigated cotton and grains industry.

This project used market research to determine the extension needs for healthy soils irrigated cotton areas in NSW and Queensland. Existing information was collated and reshaped into an extension program consisting of training workshops, field days, regional soil forums, published case studies and on farm demonstration sites.

The extension program provided relevant regional information, primarily targeted at agribusiness, consultants, irrigated cotton and grain growers, government agency staff and regional natural resource management bodies.

Twelve case studies were published. A soils web page was rejuvenated on the Cotton Catchment Communities CRC web site and materials were provided to the National Healthy Soils Knowledge Bank. The project financed ten growers and consultants to enable them to attend the National Healthy Soils Forum.

Three regional healthy soil forums were held in Goondiwindi, Narrabri and Hillston. They were well attended with 74 per cent of respondents stating the forums had provided them with information that would change the way they would farm in the future.

Fifteen training workshops on soil nutrition, soil pits, understanding soil testing and property planning were delivered to agribusiness, consultants and farmers. 75 per cent of respondents thought the information in the workshops would increase their profitability, 88 per cent thought it would increase their sustainability and 100 per cent thought the workshops proposed useful indicators to assess soil health.

Other outcomes included:

- Practice change and intended practice change by irrigated cotton and grain managers and landholders
- Improved knowledge of R&D managers and extension providers through market research to ensure well targeted research
- Improved knowledge and collaboration of soils extension providers between regional body staff and Cotton CRC, CSIRO, NSW DPI and Queensland DPI & F in the Condamine, QMDC, Border Rivers, Gwydir, Namoi, Lachlan and Macquarie catchments

The project has met or exceeded all of its milestones. It succeeded in delivering a consistent message across the entire irrigated cotton and grain growing region of eastern Australia. Feedback from the workshops and regional forums indicate that this extension project was effective in changing practice to improve both profitability and sustainability of irrigated cotton and grains through encouraging best management of healthy soils.

3.0 Introduction

The irrigated cotton and grains industry has devoted a lot of energy into research and development of best management soil management practices. However, in the cotton industry other issues had become higher priorities and there has not been a concerted effort to update soils extension information for more than a decade. There was a genuine need to collate and update existing information, identify other areas of healthy soils which need addressing and develop an effective and consistent healthy soils extension program in order to put the focus on soils once again.

In 2002, the cotton industry undertook a survey looking at existing cotton information resources and whether they were being used by the industry. The survey found that the resources were being used and were highly valued but that there were some gaps in the existing information such as soil health. In 2005, a follow up study (Shaw, 2005) was commissioned by CRDC & Cotton Catchment Communities CRC to determine what farmers current knowledge and understanding of soil health and management issues were and to identify the cotton industry's 'soil health' needs in order to enhance the research and extension effort in this area. Farmers stated that they felt that they were not receiving adequate extension information about soil health issues.

The project is of regional and national significance as it provided coverage of the entire cotton industry in NSW and Qld. Most cotton farms are on riparian floodplains and best practice soil management is imperative to the sustainability of these landscapes. It focussed on the national research priority of "An Environmentally Sustainable Australia" and linked with other projects of the LWA Healthy Soils Program. Regionally, the natural resource management bodies identified improved soil management in their action plans and links with these bodies were established.

4.0 Project summary

Project objectives:

Within irrigated cotton and grains areas of NSW & QLD

1. Develop, collate and reshape an extension program that provides a good foundation of soil health principles and management to increase the knowledge of growers
2. Target farm advisers and agribusiness to increase knowledge on soil health
3. Develop and implement locally relevant integrated soil management strategies that increase the capacity and motivation to adopt good soil management practices;
4. Improve access to existing soil health information through the provision of a range of tools, advisory services, resources and extension activities, and;
5. Assist growers and advisers develop and implement on-farm monitoring systems that also encompass catchment outcomes.

Summary of Methods and Modifications:

The cotton industry has an established and successful extension program related to growing cotton profitably and sustainably. While the health of the soil is an integral part of profitable and sustainable cotton growing, it has not been the focus of an

extension program for many years. Nevertheless, there is an effective extension network operating which enables advisers and growers to be targeted on specific issues (such as soil).

There is a wide range of extension material on soil health available to cotton advisers and landholders. A proportion of this has already been collated on the COTTONpaks CD which has been produced and distributed by the Cotton CRC and the cotton Research and Development Corporation. There is however, considerable soil health information which, while relevant to the irrigated cotton and grains industry, has not been specifically targeted to them.

Rather than try to recreate soil extension articles, this project focussed on collating existing soil extension information for irrigated cotton and grains, targeting relevant soil health issues to specific locations and extending this information through a number of workshops, forums, case studies information transfer. This was specifically done through:

- Employment of a soil extension specialist (Helen Squires)
- Identifying specific soil health issues in the cotton and irrigated grains industry by undertaking a benchmark survey and holding focus groups in key irrigated cotton and grain growing catchments
- Completing training workshops, forums and farm field days on these priority issues
- Active participation in the National Healthy Soils Conference
- Completing case studies on relevant healthy soils topics promoting technology transfer
- Providing relevant extension documents to the Healthy Soils Knowledge Bank
- Communication with cotton and grain communities, urban communities and wider industry through industry publications, local newsletters and newspapers.

5.0 Project Evaluation

5.1 Statement of Results

Outputs

- Completion of market research on grower needs for soils health
- Completion of a benchmark survey on farmer practices related to soil health in 2005
- Appointment of a soil extension specialist (Helen Squires)
- A steering committee was formed and met at regular intervals throughout the project
- A project partners workshop was held on July 31/August 1 2006 which identified possible case study topics and determined training sessions and industry needs.
- Eight soil health focus groups were held across the industry in NSW at Narrabri, Moree, Hillston, Hay and Mungindi and in Queensland at Goondiwindi, St George and Dalby with phone interviews conducted in the Emerald district.

- Twelve case studies have been written on key topics for healthy soils. Five of these have been submitted to the Healthy soils Knowledge Bank, the remaining seven are currently being reviewed and will be submitted to the Knowledge Bank by the end of the project.
- Six demonstration sites have been established. These are around two key areas – sodic soils (Warren and on at Hillston), organic amendments (Hillston, Trangie, Dalby and Mungindi). These will continue for the next two years.
- Fifteen training workshops have been held on soil biology (Warren), soil pits (Mungindi, Goondiwindi, Dirranbandi, Saint George, Mullaley, Emerald, Theodore, and Carol), understanding soil testing (Moree, Dalby, emerald and Theodore), BMP Land and Water Module (Moree) and Cotton CRC soil database (Tamworth).
- Three healthy soils regional symposia were held at Narrabri, Goondiwindi and Hillston.
- Twelve people (six consultants and six growers) were financially supported to attend the National Healthy Soils Symposium, July 2007 at the Sunshine Coast.
- A large range of communication publications on HSSF project topics and HSSF promotion have been produced in industry magazines and newsletters. These include The Australian Cotton Grower, Spotlight Magazine, Cotton Outlook, Cottontails (the Cotton CRC regional newsletters), CCA (Cotton Consultants Australia) newsletter, Lower Namoi Cotton News, The Land, The Australian Landcare Magazine and Agriculture Today. A detailed list of publications is provided in the appendix.
- New web page of healthy soils information on Cotton CRC site and linked to regional NRM bodies where appropriate
- A comprehensive soil guide compiled on soil health covering soil biology, soil pits, soil nutrition and measuring soil health



Growers and advisers at a soil health field day, Hillston, March 2007

Outcomes:

- A streamlined, consistent and coordinated approach to soil extension throughout the irrigated cotton and grain growing areas in eastern Australia.
- Increased sustainability of farming practices by 88 per cent, and increased profitability of farming practices by 75 per cent of participants in the soil health workshops.
- Increased knowledge of soil testing principles by 98 per cent of farm advisers and growers attending soil health workshops.
- Practice change and intended practice change by irrigated cotton and grain managers and landholders
- Market research has improved the knowledge of R&D managers and extension providers to ensure well targeted research
- Improved knowledge and collaboration of soils extension providers between regional body staff and Cotton CRC, CSIRO, NSW DPI and Queensland DPI & F in the Condamine, QMDC, Border Rivers, Gwydir, Namoi, Lachlan and Macquarie catchments
- Improved knowledge for the Cotton BMP process
- The benchmark survey will enable better tracking of project outcomes as time progresses.

Outcomes from Healthy Soils Regional Forums:

Three Healthy Soils Regional Forums were held in Narrabri, Goondiwindi and Hillston. All respondents were asked to submit an evaluation sheet which had been modelled around the Queensland grains HSSF project to try and gain some consistency across projects. Twenty per cent of respondents were farmers, 39 per cent were commercial agronomists or consultants, 27 per cent were government employees and fourteen per cent were catchment health or Landcare officers. From a total of 44 evaluations submitted, 98 per cent of respondents would like to see more healthy soils forums. The following table summarises some of the questions asked in the forums:

Percentage respondents who:	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
Increased my knowledge of soil health	2	0	11	82	4
Helped me to understand how farming practices influences soil health	0	4	7	80	9
Proposed useful indicators to assess soil health	2	7	31	56	4
Will help me to increase the profitability and sustainability of my practices	2	5	51	37	5

Outcomes from Healthy Soils Workshops:

A total of sixteen healthy soil workshops were held during the life of the project. Of the evaluations received, 98 percent of respondents thought the workshops were very useful, 98 per cent thought the workshops increased their knowledge of soils and 100 per cent thought the workshops proposed useful indicators to assess soil health. The workshop met 98 per cent of the respondent's expectations and taught at a level that

88 per cent could understand. 96 per cent of respondents would recommend the workshops to others.

Higher Outcomes

Higher outcomes include practice change and a shift in attitudes. Both are very difficult to measure – practice change may take several seasons – especially in the light of chronic water shortages reducing the amount of irrigation in some areas by up to 90 per cent. Practice change is difficult when economic hardship and lack of water prevent any farming. Nevertheless, at the forums, 74 per cent of respondents thought the forums had provided information which would change the way they would farm in the future. At the workshops, 75 per cent of respondents thought the workshops would increase the profitability of their practices and 88 per cent thought the workshops would help them increase the sustainability of their practices.

Unintended Outcomes

The Healthy Soils project had a number of unintended outcomes:

- Interest in Nitrogen Use Efficiency (NUE). Nitrogen use efficiency was being promoted as a pathway to improved soil health. During the course of the project, two things happened which made this topic more relevant: the price of nitrogen increased significantly and a great deal of interest in NUE was generated from the increase in interest of the role nitrogen plays in the emissions of greenhouse gases from agricultural pursuits (particularly irrigated agriculture). This meant that NUE became much more popular – in terms of the amount of money which could be saved and also in terms of the potential to reduce greenhouse gases in irrigated agriculture. One of the early case studies was on greenhouse gases and nitrogen use efficiency. This has been published on the Cotton Catchment Communities CRC website and has been the eighth most popular download on their website.
- The interest garnered in soil health by high level and influential people in the irrigated cotton and grains industry. This was highlighted when the head agronomist for Cubbie Station was sponsored to attend the national Healthy Soil Symposium. After attending the symposium, he offered Cubby station as a venue for future workshops.
- The interest generated by farmers and natural resource specialists. While the project was primarily targeting farm advisers and agribusiness (objective 2) there was considerable interest from farmers who made up 56 per cent of workshop attendees and 20 per cent of regional forum attendees. This should be seen as an important indicator for shaping future healthy soils activities.

5.2 Evaluation of Results

Interpretation and practical significance against each objective.

Objective 1: Develop, collate and reshape an extension program that provides a good foundation of soil health principles and management to increase the knowledge of growers.

This project used the benchmark survey and the eight key focus groups to guide regionally relevant and targeted soil health extension across the eight irrigated grain and cotton growing catchments in NSW and Queensland. From this, extension material was collated, forums and workshops were held and case studies were written to support relevant soil health topics. While there was a lot of information to support soil health in the irrigated grains and cotton industry, this needed collating. Up to date perceptions and knowledge requirements on soil health is also important and this project delivered this. The result was an extension program which brought soil health to the forefront of growers and advisers in cotton and irrigated grain growing areas of eastern Australia.

The benchmark survey provided a starting point to determine the impact of soil health extension programs on the knowledge and attitudes of growers and advisers. The focus groups enabled soil extension information to be tailored to suit the eight different growing areas while providing a consistent message across the entire area. The focus groups also identified gaps in knowledge and the eleven case studies were targeted at these gaps in knowledge.

Evaluation of the soil health workshops determined that 98 per cent of attendees thought the workshops increased their knowledge of soil testing principles, 100 per cent thought the proposed useful indicators to assess soil health, 75 per cent thought they would increase the profitability of their farms and 88 per cent thought the workshops would increase the sustainability of their practices.

Objective 2: Target farm advisers and agribusiness to increase knowledge on soil health.

Eighty per cent of people attending the regional forums and 44 per cent of people attending the workshops were commercial agronomists, consultants, government agency staff or community NRM groups. Farm advisers and agribusiness were targeted for all the extension activities addressed and the level of knowledge of these extension activities was also targeted to this audience. Farmers showed a significant interest in this project and in hindsight this group could have been better serviced by this project.

Objective 3: Develop and implement locally relevant integrated soil management strategies that increase the capacity and motivation to adopt good soil management practices.

Because of the wide area this project covered, the level of knowledge and interest in each catchment on soil health issues varied. The key focus groups helped implement

particular soil management issues to relevant areas. Because of the wealth of information on soil health, rather than try and provide integrated soil management strategies, this project endeavoured to integrate specific soil management strategies into crop management programs. This approach seemed to work very well.

From the focus groups, 19 soil health issues were provided and each focus group determined if these issues were a priority in their area. This information was used as the bases for developing relevant soil health workshops and for directing the content of the regional forums. A summary of this is provided in Table 1.

	Lachlan	Murrumbidgee	Central West	QMDC	QMDC & Border Rivers/ Gwydir		Border Rivers/ Gwydir	Namoi	Fitzroy	Condamine Alliance
Soil Health Issue	Hillston	Hay	Warren/ Trangie	St George/ Dirranbandi	Goondiwindi	Mungindi	Moree	Narrabri	Emerald	Dalby
Hard setting soils										
Sodicity										
Organic matter. Its role and economics to improve it.										
Soil Biology in general. What is it & its benefits?										
Biological products. Comparison of different products.										
Benefits/constraints of different irrigation techniques from soil health point of view										
Impacts of poor water quality on soils										
Application of EM maps										
Nitrogen efficiency										
Understanding different fertilisers										
Fertiliser application/timing										
Phosphorous and Potassium limitations										
Nutrient stratification & mineralisation										
Comparison of soil & foliar fertilisers										
Water holding capacity. How to improve?										
Subsoil constraints										
Benefits/economics of rotations and sacrificial crops										
How to benchmark & monitor soil health										
Fusarium										

Table 1: Priority soil health issues determined at the soil health focus groups

Objective 4: Improve access to existing soil health information through the provision of a range of tools, advisory services, resources and extension activities.

The irrigated cotton and grains industry has not had a dedicated soil advisory officer for about a decade. In some of the newly developed irrigation areas (such as Hillston) there has never been a dedicated soils advisory officer. The employment of a dedicated soil advisory officer to implement soil extension across this area worked very well. Existing soil resources have been collated, case studies published and relevant information has been submitted to the knowledge bank project and/or put on the Cotton Catchment Communities CRC website (<http://www.cottoncrc.org.au/>). This project has successfully built on a lot of good work already completed in the irrigated cotton and grains industry, raised the profile of soil health in these industries and provided a number of high profile extension activities.

Objective 5: Assist growers and advisers develop and implement on-farm monitoring systems that also encompass catchment outcomes.

The key focus groups provided information to deliver targeted workshops in all of the key irrigated industries catchments. 100 per cent of respondents to the workshop evaluations agreed or strongly agreed that the workshop proposed useful indicators to assess soil health. 14 percent of respondents to the regional forums evaluation sheets were community NRM or Landcare employees. The Cotton Catchment communities CRC also partnered with the Condamine Alliance, the Queensland Murray Darling committee, the Border Rivers Gwydir Catchment Management Authority and the Namoi Catchment Management Authority to ensure that these monitoring systems also encompassed catchment outcomes.

How Outputs can be Adopted

A significant number of attendees at the regional forums (74%) signalled that they intended to change their practices while 84 per cent of respondents at the workshops thought that they would increase the sustainability of their practices and 75 per cent thought they would increase the profitability of their practices. This suggests that many of the healthy soil initiatives will already be adopted. The workshops seemed to be very effective and 96 of respondents said they would recommend the workshop to others. A further period of providing these workshops would probably be the best method of adopting healthy soils practices.

Assessment of Commercial Potential

This project produced no outputs which have commercial potential.

5.3 Lessons

Lessons learnt from this project are:

- Collation of existing extension material can provide a significant amount of material which is relevant and up to date, even if it has not come from the irrigated cotton and grains industry.
- Benchmark surveys and focus groups are very important in getting relevant information to key clients.
- Effective extension projects often rely on a dedicated extension officer. The longer that extension officer is there (able to become an established authority and gain the trust of key clients), the more effective the project will be. This can take several years. Unfortunately, just as the extension officer was getting known, this project has ended.

6.0 Conclusion and Recommendations

6.1 For Project and Host Organisation

This project became a very effective mechanism for both extending information and instigating on ground change to improve the health of soils for irrigated cotton and grains. While the intention to change practices was recorded in the evaluation sheets, measurement of actual on ground change has not been possible. The ability of many farmers and agronomists to change has also been made more difficult by drought conditions and the fact that there has been very little water allocated in many catchments to enable farmers to grow any irrigated crops at all. Nevertheless, the project has delivered on all milestones and should be considered a success. It has delivered a consistent message across a wide area, been very efficient in collating existing soil information (rather than producing a range of similar extension publications from scratch) and given soil health the highest profile it has had on irrigated cotton and grain soils in a decade.

6.2 For Future Soils Policy and Program

There has been some discussion about the synergies between this project and the northern grains project. While there was certainly some overlap in the people attending some of these courses in northern NSW and Queensland, the ability for this project to get a consistent message across the irrigated cotton and grains industry from central Queensland to southern NSW is an advantage which outweighs this overlap.

As has been discussed at the project leader's meetings in Canberra, one consistent comment coming from key clients is that these projects come to an end just as extension officers come up to speed with the project and develop a meaningful relationship with advisers and land managers. Had the project continued for even one more year, many more workshops, forums and other extension events could have been held which would have produced a much greater impact and reached many more land managers and advisers.

There has been overwhelming demand for information on soil biology. The focus groups which were convened in each catchment at the beginning of the project all had soil biology as a high priority. However, when pressed, most groups could not define what they meant by soil biology nor specify what they wanted in terms of extension products. Soil biology should remain a priority in future programs but a detailed investigation of just what clients define soil biology as should be part of this.

In regard to recommendations for future soil policy, feedback from the workshop evaluations indicated that 75 per cent of participants thought that the information presented in these workshops would help them to increase the profitability of their practices. In the regional forums held, 74 per cent of respondents thought the forums provided them with information that would change the way they farm in the future. This suggests that from a soil management perspective, healthy soils extension is able to generate significant change which will make farming both more sustainable and more profitable.

7.0 Appendices

7.1 List of publications

Conference Publications

Roth G. and Squires H. Cotton – How far has soil health come in the cotton industry? Healthy Soils Symposium, Twin Waters, Sunshine Coast July 5-7 2007. Pp 131-139

Squires H. “Healthy Soils, Healthy Plants - Healthy Profits” Cotton CRC Science Forum, 8 - 9 August 2007

Squires H. (Ed) Healthy Soils Regional Forums Proceedings. Narrabri, Goondiwindi and Hillston, 7, 8 and 13 November 2007 52 pp

Journal/Magazine publications

Anon. “Healthy soils, healthy plants, healthy profits” Spotlight Magazine Summer 2007

Squires H. “Healthy Soils Targeting Sustainable Farming” Cotton Outlook, May 2007

Squires H. “Soil Health Questions” Spotlight Magazine Autumn 2007

Squires H. et al “Using technology for environmental and production gains” The Australian Landcare Magazine, October 2007

Rochester I. “Efficient Use of Nitrogen Fertilisers” The Australian Landcare Magazine, October 2007

Newspaper and Newsletter articles

Squires H. “Holding On To Every Drop” Ag Today 9/10/07

Squires H. “Healthy Soils Targeting Sustainable Farming” Ag Today 5/6/07

Squires H. “Healthy Soils Symposium and Workshops Targeting Sustainable Farming” Cotton Consultants Australia Newsletter, April 2007

Case Studies

O’Halloran J, Dowling C, Rochester I , 2006 How to take soil tests.

Squires H. Deep Drainage. Using electromagnetic maps to track down deep drainage. An Auscott Midkin case study. April 2007

Squires H. Greenhouse Gases. Improving Nitrogen Management and Reducing Greenhouse Gas Emissions. April 2007

Squires H. Dryland Rotations. Crop Rotations in a Dryland Cotton Farming System. A Warra, Darling Downs Case Study. April 2007

Squires H. Sustainable Farming. Bore water Quality and Rotations in Sustainable Farming Systems. A 'Beechworth' Merah North Case Study. April 2007

Squires H. Mycorrhizal Fungi VAM. Mycorrhiza after long fallows: is it still there? A mycorrhizal myth unearthed. April 2007

Squires H. Landformation. Variable Rate application of Fertilisers and Soil Ameliorants following Laser Levelling. A Macquarie Valley Case Study. April 2007

Roth G. Drip irrigation: improving soil (and water) management, April 2008

Roth G. Lateral Move Irrigation Systems: a move towards minimum tillage, April 2008

Roth G. Long term soil health monitoring: a 30 year case study in the Condamine, April 2008

Roth G. Reducing fertiliser costs with vetch, April 2008

Roth G. Soil Biology solutions, April 2008