

# Final Report

On Farm Series | Cotton Research & Development Corporation

*If you are participating in the presentations this year, please provide a written report and a copy of your final report presentation by 31 October.  
If not, please provide a written report by 30 September.*

## ***Part 1 - Summary Details***

*Please use your TAB key to complete Parts 1 & 2.*

**CRDC Project Number:** CLW1101

**Project Title:** Validate and extend the IrrigATEWAY irrigation management tools into the cotton industry

**Project Commencement Date:** 1/10/2010 **Project Completion Date:** 30/06/2011

**CRDC Program:** Commissioned research Proposal

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**Signature of Research Provider Representative:**



## ***Part 3 – Final Report Guide***

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### ***Background***

Water management in the cotton industry has continued to be of fundamental importance to sustainability and production. Great advances have been made with the adoption of single site measures of soil moisture. These types of technologies have greatly increased knowledge of the water relations in cotton farming systems. There are numerous advantages associated with improved scheduling techniques including:

- The management of water between fields to minimise crop water stress and maximise productivity.
- Improvements in energy, water and labour efficiency through more effective irrigation.
- An increase in Water Use Efficiency and fertiliser effectiveness through reduced surface runoff and deep drainage.
- Increased net returns through increased yields and improved crop quality.

New technology has been operational in other agricultural industries which presents data spatially, in suitable timeframes and at low cost. The capture and presentation of large amounts of quality data is a major farm management constraint. Dealing with climate variability requires the tools of management to be more sensitive to atmospheric factors. Irrigation scheduling has traditionally relied upon measures of soil water status. The IrriSAT suite of tools integrate atmospheric measurements with plant vigour measurements, creating tools which reflect very well the current climate, including any extremes and spatial variability in crop growth.

The IrriSAT tools capture a foundation dataset for the reporting and management of variability of plant water use. With experience this will allow the convenient benchmarking of water productivity, a surrogate for environmental performance.

The validation of the IrriSAT suite of tools in the cotton industry will provide a range of benefits to the industry, very few of which can be translated into propositions for independent commercial investment. Water management is a whole of industry issue, new technology in this area is extremely valuable and needs to be explored.

Scheduling methods have been dominated by soil moisture measurements, however more recently cotton consultants have been looking at evapotranspiration as an estimate of plant water use. A current problem with weather based methods is having a suitable crop factor to estimate crop water use.

### **IrriSAT Approach**

Irrisat is a weather based irrigation scheduling service. It uses satellite imagery to better determine crop coefficients that are needed to calculate crop water use.

The system uses local weather stations to measure sunlight hours and intensity, cloud cover, rainfall and wind which are all used to calculate a reference crop water use in the past 24 hours. This information when combined with the satellite-determined crop coefficient for a

particular crop allows an actual crop water use figure to be calculated. The main limitations with weather based scheduling methods is the need for representative evapotranspiration (E<sub>to</sub>) measurements and most importantly reliable crop coefficients which have been difficult to obtain on a site specific basis.

The main issue in calculating crop water use (E<sub>Tc</sub>) is obtaining a reliable crop coefficient (K<sub>c</sub>). These have been established for different crops over a number of growth stages, but textbook references such as FAO 56 can differ markedly to what is actually happening in the field.

Crop management including water and fertiliser management, along with soil type and even varietal differences will change the crop coefficient between paddocks of the same crop even across the same region.

In order to overcome these limitations the IrriSAT system involves the installation of a network of 2 to 4 weather stations across the area so reliable estimates of E<sub>to</sub> can be obtained. Most importantly satellite images are used to determine crop coefficients for individual fields frequently over the entire growing season. These satellite images show different vegetative growth stages of the crops grown in the region which can be directly related to a site specific crop coefficient, hence providing a site specific measure of crop water use which can be used in irrigation scheduling.

Figure 1 shows an overall flow diagram of the IrriSAT system. Two information feeds (E<sub>to</sub> from on-ground weather stations and forecast E<sub>to</sub>) are combined with satellite derived crop coefficients to determine individual paddock water use on a daily basis. This information is then processed and delivered through a web based interface to irrigation managers.

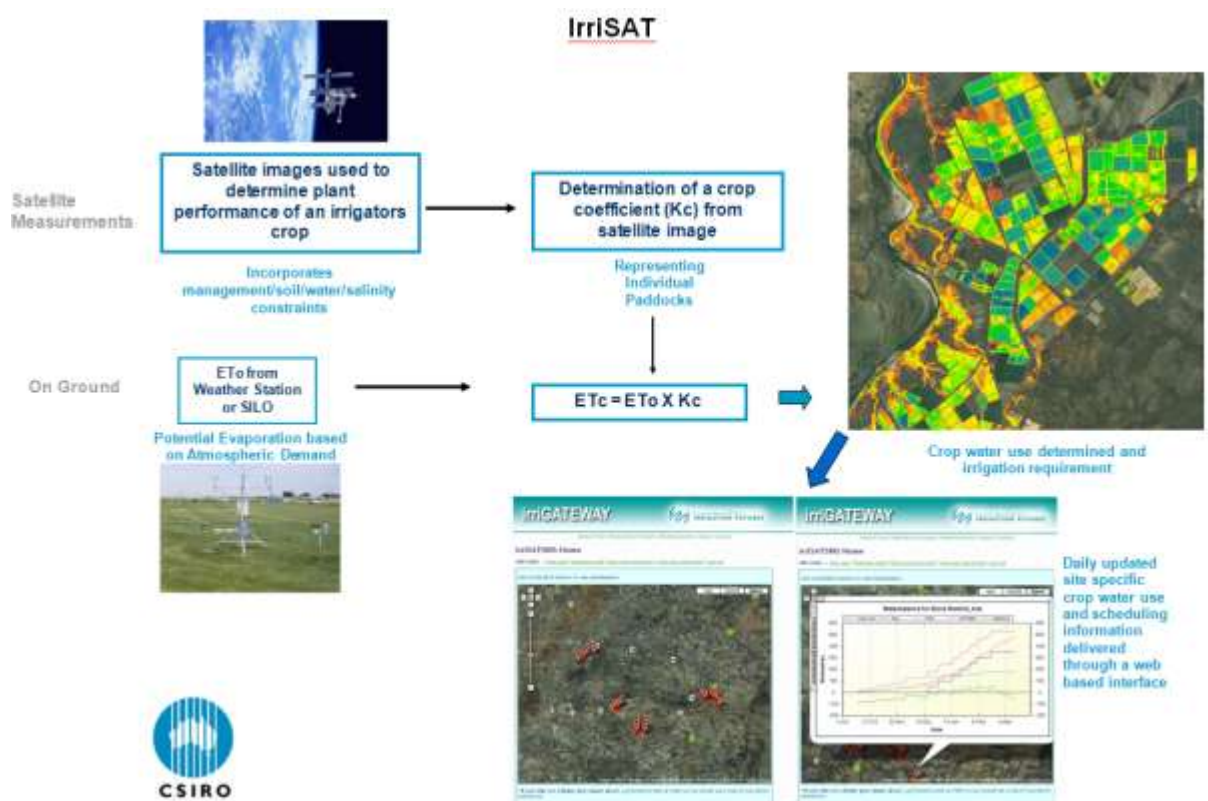




Figure 1: IrriSAT system showing information flows and linkages between sensing and information delivery platforms.

Researchers have found a strong relationship between Normalized Difference Vegetation Index (NDVI) and crop canopy cover. NDVI is a ratio between 0 and 1 of the red and near infrared reflectance by plants. This index is calculated from the satellite image data where larger, greener canopies give higher NDVI values than smaller or less healthy crops.

Canopy cover is a direct driver of crop water use allowing a relationship to be developed between NDVI values and crop coefficients. This relationship has been found in a large range of crops however, this is the first time the relationship has been established for irrigated cotton.

The IrriSat service calculates individual crop coefficients for each 30m x 30m section (or pixel) of the satellite image, which are averaged to provide a Kc value for a particular field.

In summary, once the NDVI data has been derived for a particular crop and field, it is then converted to a Kc value and used to determine crop water use by combining Kc with the ETo data collected from a nearby weather station.

## *Objective*

The objective of the study was to determine the suitability of the IrriSAT system for providing water management information to consultants to improve water use efficiency in cotton crops.

Specifically this included:

1. Undertaking limited trials comparing IrriSAT derived measures of crop water use with existing techniques
2. Conducting trials with irrigation based consultants to assess the applicability of the IrriSAT system to their current operations and the usefulness of the tool to fill knowledge gaps in water management related to irrigation scheduling and benchmarking

## *Methods*

The IrriSAT trial was undertaken during the 2010/2011 irrigation season. Ten consultants took part in the trial with 304 individual paddocks or blocks being monitored through the irrigation season. Total area monitored was approximately 20 000 ha.

In order to assess the system a range of cotton production layouts were included in the trial. This included solid, skip and double skip row configurations and also dryland (non-irrigated cotton) fields. This provided a range of crop water use ensuring the IrriSAT approach was trialled across a wide range of irrigation/agronomic practices.

Individual irrigation consultants were provided with training and login details to use the IrriSAT web portal. Data was then collected on irrigation volumes and rainfall volumes through the portal. This information was then combined with the IrriSAT crop water use data to calculate and on a daily crop water deficits. This information was then presented through the portal so that participants could use the information during the irrigation season and also undertake post irrigation season assessment. Additional information such as yield was also collected for blocks on the IrriSAT system and used to investigate the potential of IrriSAT in yield prediction and water use efficiency benchmarks.

### IrriSAT derived Crop Water Use

In order to assess the accuracy of the IrriSAT derived crop water use (ET<sub>c</sub>) figures and provide validation of the methodology, the IrriSAT system was applied to the Gwydir Valley Irrigators Association (GVIA) field trial at Redmill, Moree, NSW. A number of planting configurations (Solid, Skip, Double skip) and irrigation regimes (Full and Limited) were installed and monitored and results compared between IrriSAT and on-ground water use estimates determined through soil moisture monitoring and field water balance measurements.

**Results**

**Development of an Reference Evapotranspiration (ET<sub>o</sub>) forecasting system**

A weather station network was set up to provide real-time information for the IrriSAT system. Real-time ET<sub>o</sub> information can be accessed by any interested party direct through the web (<http://www.irrigateway.net/weatherstations> ). The site provides real time data graphically and also facilitates for downloading data for the two weather stations setup for the IrriSAT project. Screenshots of the website and data portal are shown in Figure 2.

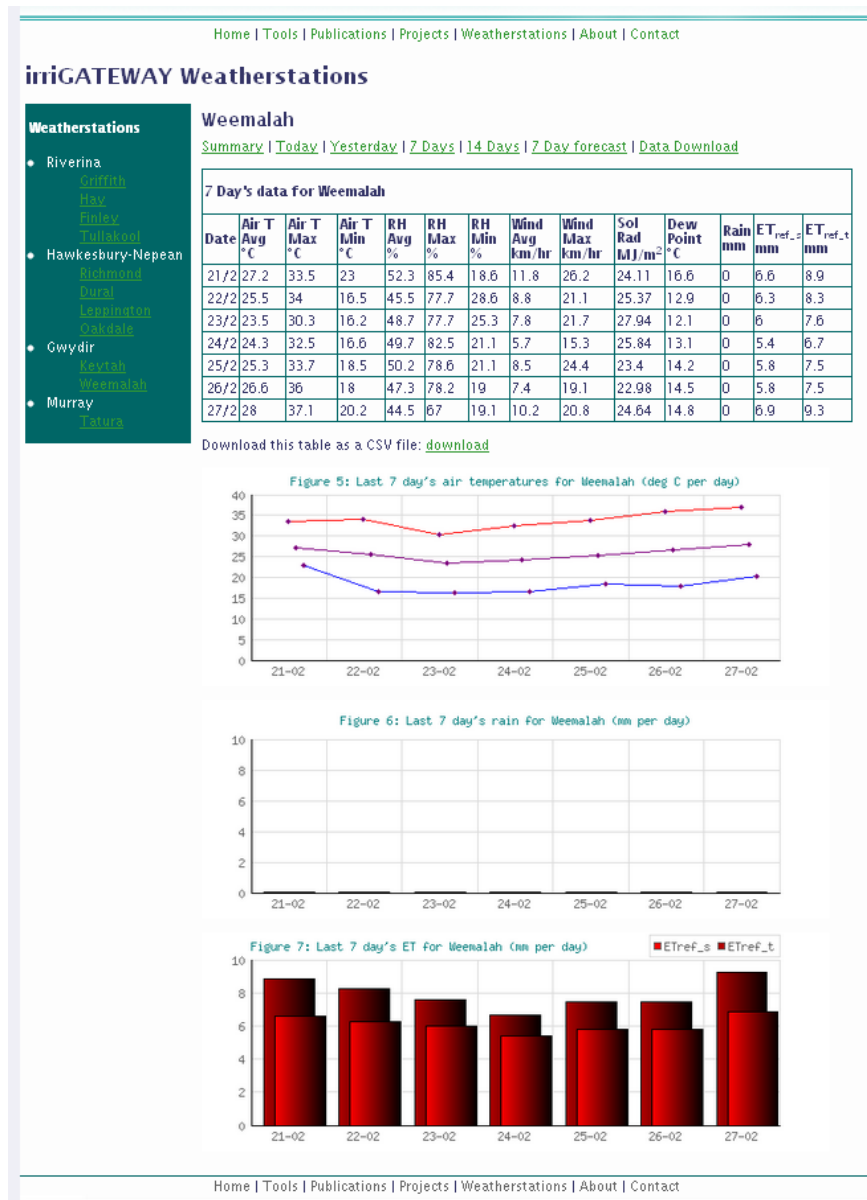


Figure 2: Screenshots of Irrigateway website containing ET<sub>o</sub> and Forecast Eto weather data and IrriSAT user interface/portal.

In addition a forecasting service was also developed using the 7 day Operational Consensus Forecasts provided by the Bureau of Meteorology <http://www.bom.gov.au/catalogue/data-feeds.shtml>. This raw forecast data (Temp, Humidity, Wind Speed etc) has been converted into a 7 day ETo forecast by CSIRO which was used in IrriSAT to forecast water needs 7 days in advance. Current forecast data is available on the IrriGATEWAY website for each of the regions where IrriSAT is being implemented, see [http://weather.irrigateway.net/?aws\\_id=6&view=7dayforecast](http://weather.irrigateway.net/?aws_id=6&view=7dayforecast). This ETo forecasting system provided the basis for the ETo feeds into the IrriSAT system on a daily basis.

### **IrriSAT validation**

One of the key questions regarding the IrriSAT approach was its ability to differentiate cotton crop water use with different row configurations. Figure 3 shows cumulative seasonal crop water use for two irrigation configurations and a dryland double skip cotton crop. It can be clearly seen from the figure that the IrriSAT approach is able to differentiate the different water use patterns of the three crops over the growing season.

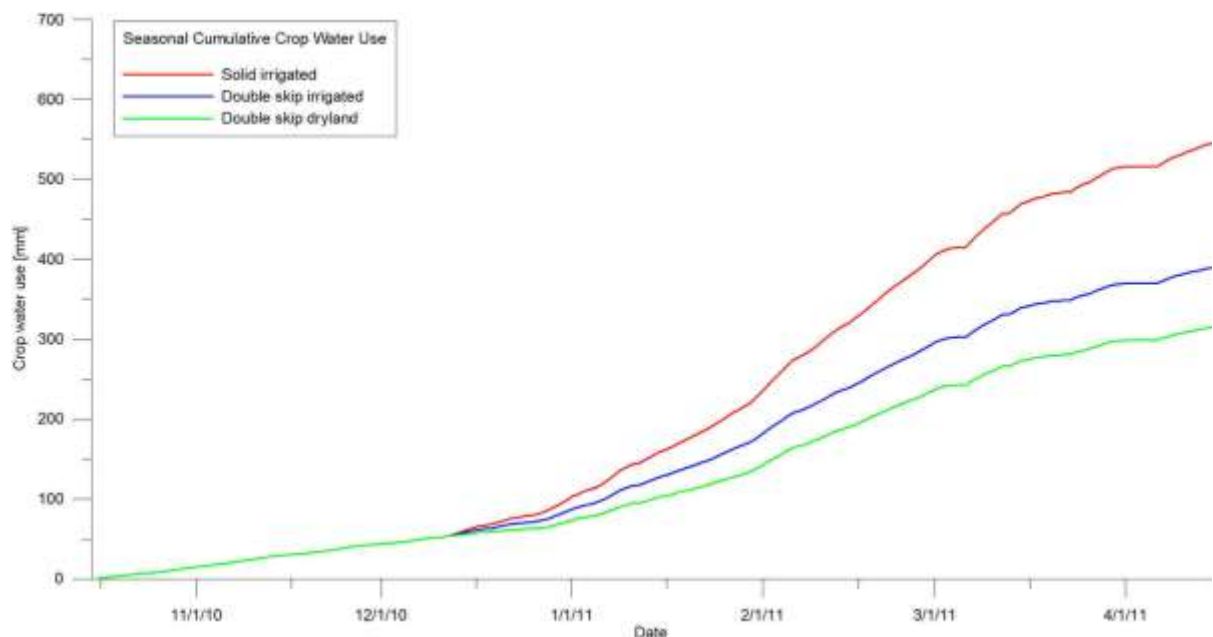


Figure 3 Seasonal cumulative crop water use for different row configurations as determined by IrriSAT

In order to compare the IrriSAT derived crop water use (ETc) figures with on-ground measurements an experiment was undertaken at the GVIA Redmill trial site. IrriSAT derived ETc figures were compared with ETc figures derived through a waterbalance approach measured on-ground.

Figure 4 shows the Redmill trial site and calculated seasonal ETc figures for treatments used at the site. The IrriSAT ETc figures for treatments ranged from a low of 430 mm to a high of 710mm across the treatments blocks. These figures compared to within  $\pm 50$ mm of figures determined through on-ground soil moisture monitoring. Based on these initial investigations and comparisons, combined with qualitative feedback from the irrigation consultants who took part in the trial it appears that the IrriSAT approach to determining crop

evapotranspiration is able to adequately determine ETc and provide reliable estimates which can be used for irrigation scheduling and benchmarking crop water use.

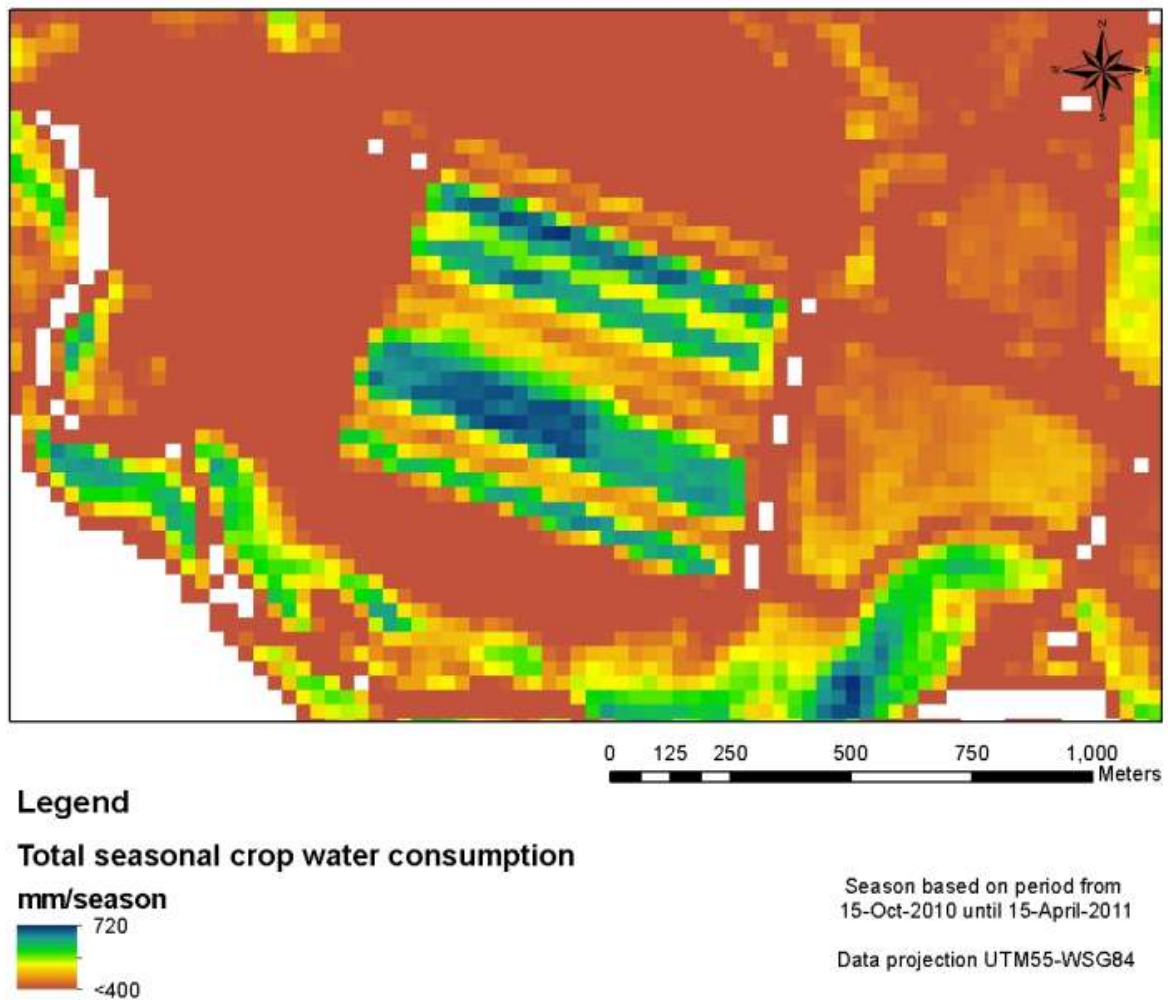


Figure 4 Total seasonal crop water consumption over the Redmill trial site.

**Outcomes**

Based on the results of the trials and feedback received from the trial participants there are three potential applications of the IriSAT technology which could benefit the cotton industry. These applications are detailed in the following sections along with details on further investigations and work which would need to be done on each element. Indeed as a package the IriSAT system offers the cotton industry important information on irrigation scheduling and management, regional water use benchmarking and potential yield forecasting/predicting based on results from this trial

## IrriSAT for Irrigation Scheduling and Management

The main purpose of the IrriSAT system is to provide a low cost, site specific irrigation water management tool that can be applied over large areas. The IrriSAT web portal is available in a Google maps interface which allowed consultants to monitor between 10-50 individual irrigation management units. For each management unit waterbalance information is calculated from the IrriSAT system and displayed in a cumulative graph over the irrigation season. Data is updated daily using weather station data and forecast ETo combined with satellite derived kc data which is updated on a 7-14 day interval. Figure 4 shows a typical waterbalance graph for one irrigation management unit.

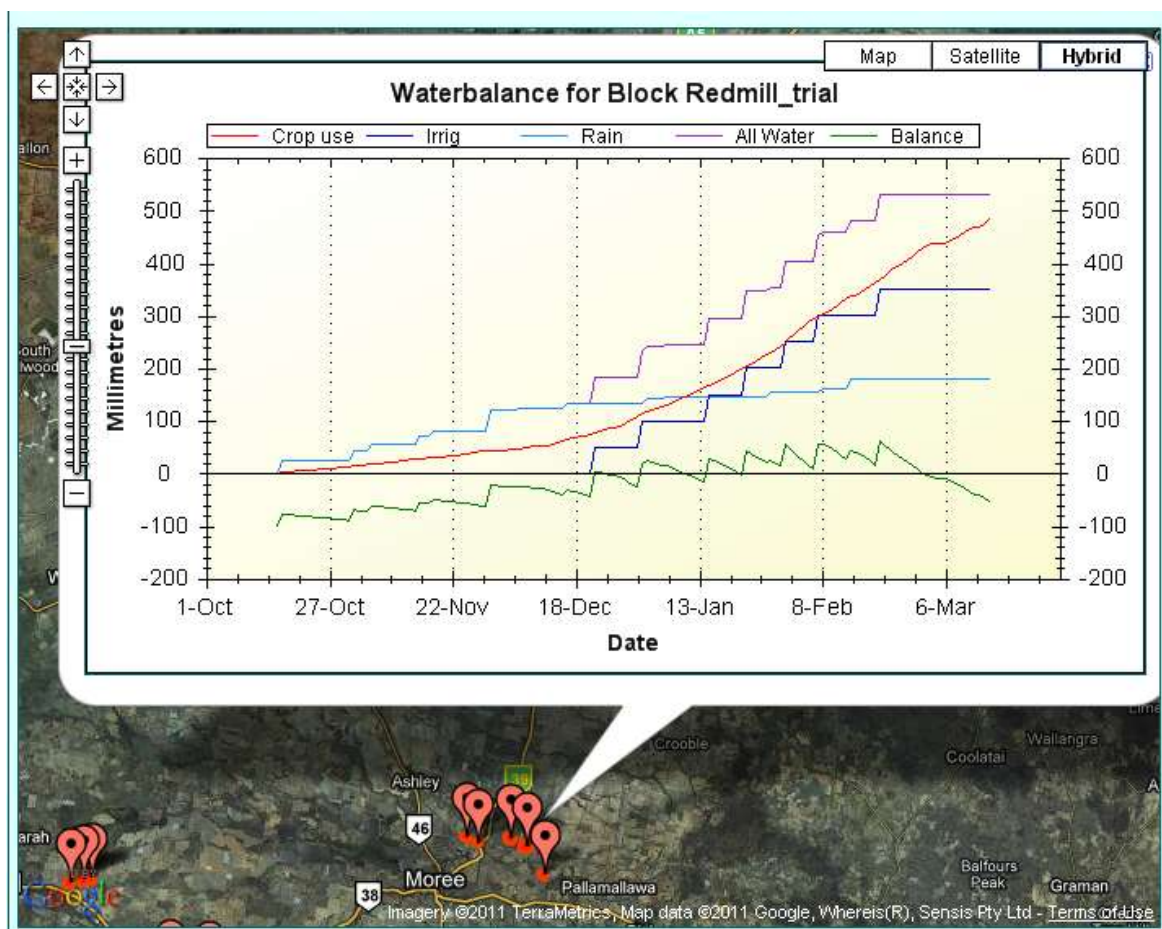


Figure 4 Waterbalance graph for an individual irrigation management unit

This data can be used in irrigation scheduling and provides an approach which tracks a water balance deficit similar to a soil moisture probe. Additionally the IrriSAT tool can also be used to look at spatial variability across an irrigation management unit at a 30x30m basis (Figure 5).

## Gwydir (prototype)



Figure 5 Spatial variability of water use across irrigation management units

These benefits combined with the low cost of the approach offers irrigation managers the ability to monitor large areas in high resolution which aids in irrigation decision making. In order to integrate this approach further with the current irrigation scheduling tools the trial participants have recommended some changes to the way in which data is displayed and integrated with existing technology such as soil moisture probes. Additionally new ways of automating data input on irrigation and rainfall should be investigated. The trial consultants have also identified the usefulness of the tool for looking retrospectively over the irrigation season to see how effective and efficient irrigation decisions were.

The consultants indicated that the tool has great potential. Although most indicated they would not replace soil moisture probes, they thought the technology has the potential to add value to irrigation scheduling making and particularly to provide information on spatial variability which probes cannot do due to high costs. It was also indicated that the ability to provide ‘absolute’ water use data which can be used to compare paddock to paddock performance from a waterbalance perspective is highly useful. This cannot be done with ‘relative’ data from a soil moisture probe in which readings are generally site specific in nature and cannot be compared across paddocks. Ideally the participants indicated that what needs to be developed is a package that can link both IrriSAT and soil moisture probe data together in a single framework for irrigation decision making.

## IrriSAT for regional WUE benchmarking

One of the benefits of the IrriSAT approach is that it covers large areas at low cost and provides estimates of actual crop evapotranspiration data that can be used for benchmarking the performance of cotton crops. This feature was seen by the trial participants as extremely useful in being able to benchmark water use efficiency across a region combined with yield and/or financial data for benchmarking and decision making purposes. Figure 6 shows total seasonal crop water consumption across the Gwydir valley for the 2010/2011 irrigation season. Feedback from the trial participants indicated that this water use efficiency benchmarking using the IrriSAT approach was an extremely valuable tool for the cotton industry to track its performance and also to show how it compares to other industries and water users. Indeed many participants noted the seasonal water use of the Gwydir wetlands in comparison to the cotton growing areas.

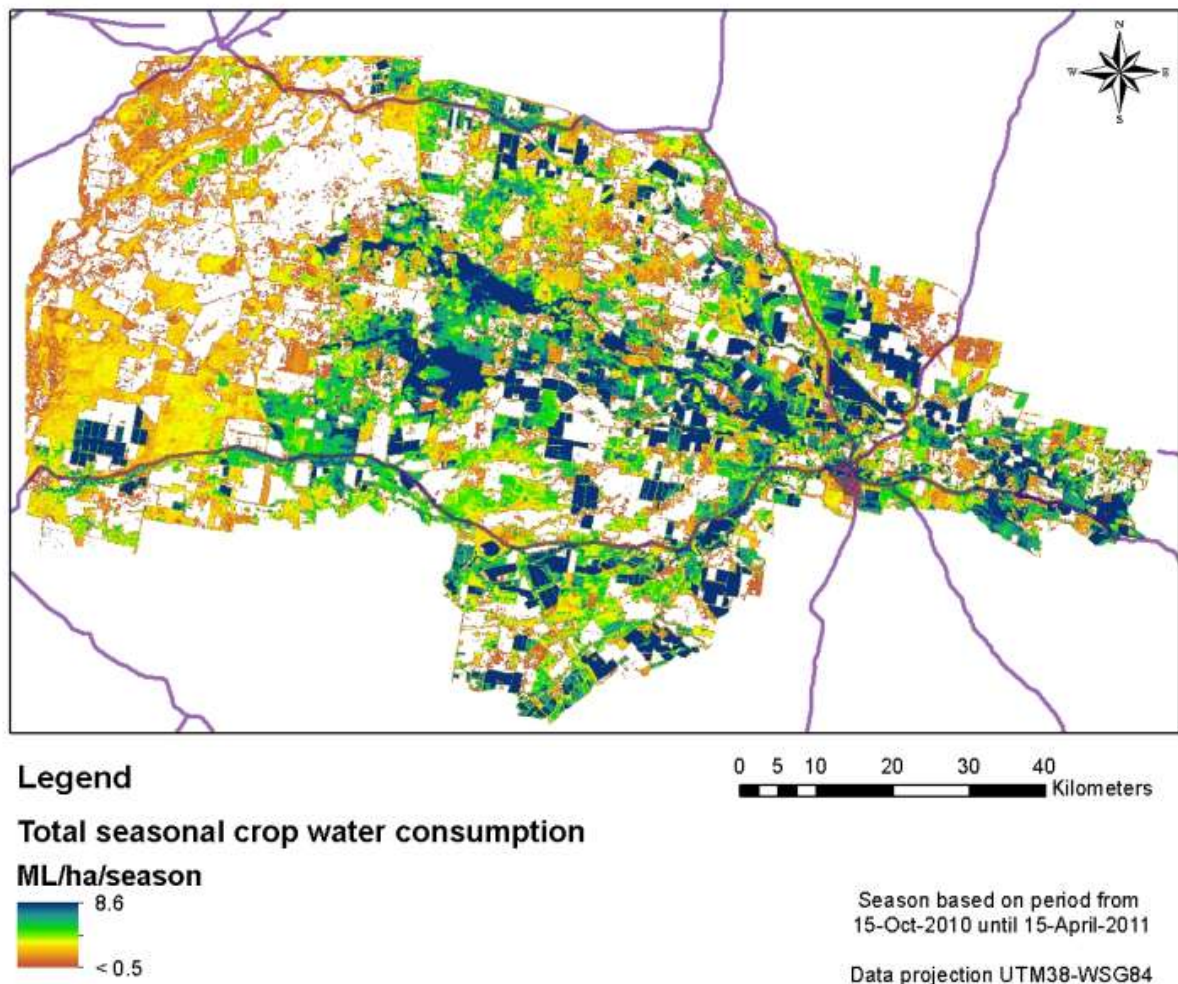


Figure 6 Total seasonal crop water consumption across the Gwydir valley

**IrrisAT as an in season yield prediction tool:**

Due to the strong relationship between ETc and crop yield for most crops an initial investigation was made (at the request of some trial participants) into the use of the IrrisAT derived ETc figures for use as a yield predictor late in the irrigation season. This was undertaken by collecting and collating yield data from as many of the IrrisAT field monitored sites as possible. Figure 7 presents the yield vs ETc relationship derived using IrrisAT calculated seasonal crop water use and the yield data supplied. It can be seen that there is a strong overall relationship between ETc and yield. Indeed row planting configuration can be clearly seen on the figure. There are also clear thresholds in yield and seasonal crop water use for the different planting configurations. This initial assessment provides confidence that with further refinement IrrisAT could potentially be used to provide an indication of yield potential for the current cotton crop, later in the irrigation season.

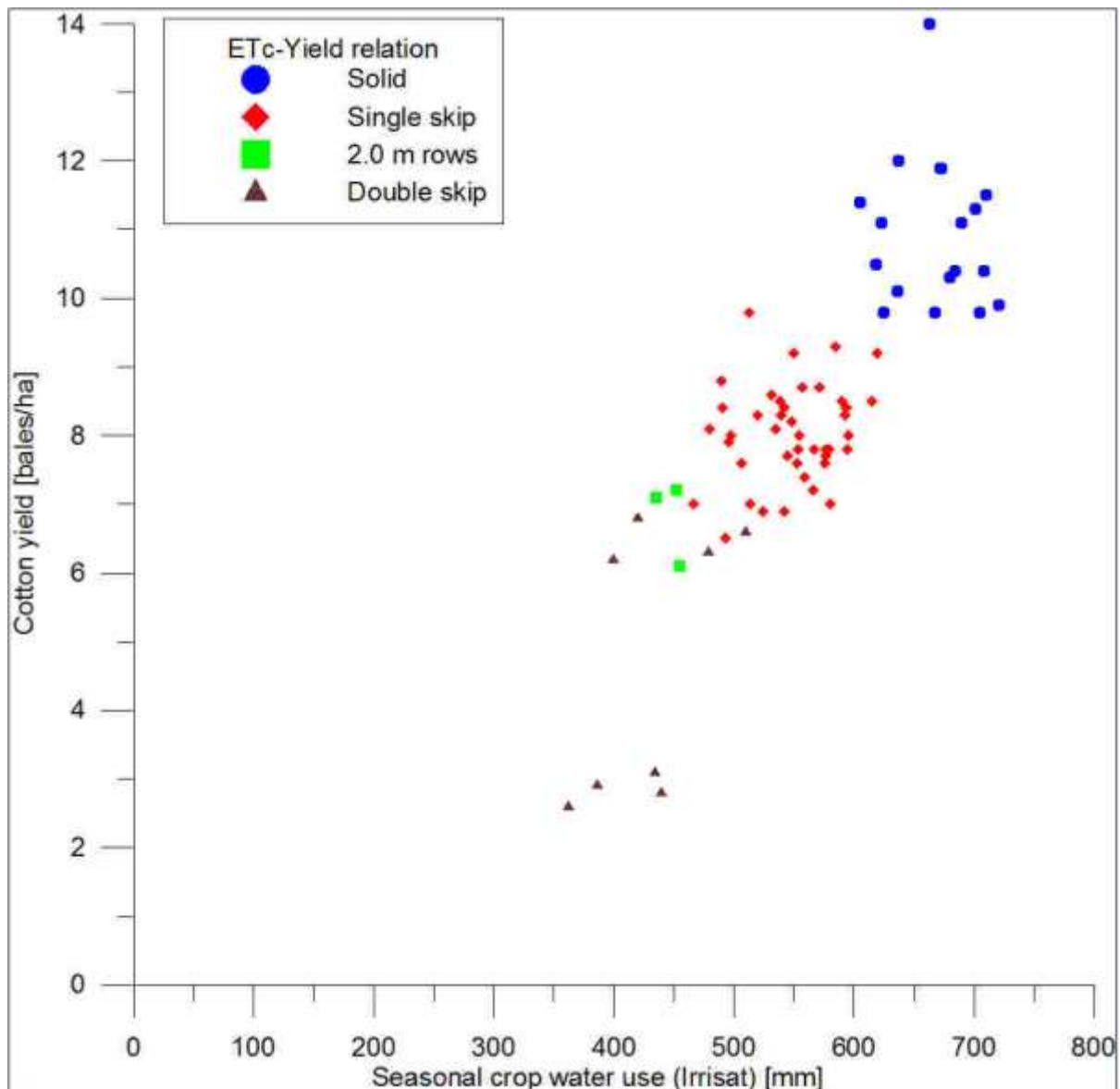


Figure 7 ETc – yield relationship for cotton

## ***Conclusion***

The IrriSAT approach has the potential to provide a significant benefit for the Australian cotton industry. This initial 1 year trial has shown the potential of the IrriSAT system for providing site specific irrigation scheduling information, regional water use benchmarking and potentially in season yield forecasting. Each one of these components have clear benefits for the cotton industry which were identified by the trial participants. From this initial trial it was clear that there is significant interest in the approach by water managers in the cotton industry and benefits for water management. However as identified in the trial there is still some refinement which is needed to specific elements of the approach to fit in with existing systems and practices.

## ***Extension Opportunities***

1. Detail a plan for the activities or other steps that may be taken:
  - (a) to further develop or to exploit the project technology.

It has been indicated by the trial participants that there are areas which need further development with IrriSAT to refine the approach and link with existing technologies such as soil moisture probes. These have been detailed in the report. It is also clear that the technology can potentially be used for a range of water use and benchmarking studies which could provide a wealth of information for the cotton industry that can be used to increase production and improve water use efficiency. Based on feedback at field days and conferences there are a number of people who wish to use the IrriSAT product across the McIntyre, Gwydir and Namoi valleys and we are in the initial stages of developing a project to assist with this.

- (b) for the future presentation and dissemination of the project outcomes.

The project team is undertaking a series of talks at major meetings/field days and conferences to present the results of the findings. These are listed below in the project publication section.

- (c) for future research.

There are some elements of the IrriSAT system which need further research and refinement to suit industry needs. These include the yield forecasting potential (which was only briefly tested during this initial research phase, but shows great promise). These have been identified in this initial trial and currently a project plan is being developed to seek funding to allow these areas to be addressed and further refined. There was also an identified need to offer the tool in other cotton growing areas which were not covered by this trial i.e. McIntyre Valley.

8. A. List the publications arising from the research project and/or a publication plan.  
(NB: Where possible, please provide a copy of any publication/s)

Publications and extension material from the work included:

1. Newspaper Article – The Land
2. Macintyre Valley Cotton Field Day Handout
3. Redmill GIVA Field Day Handout
4. Irrigation Australia Limited 2011 National Irrigation Conference Paper “Piloting IrriSat technology in Irrigated Cotton”
5. Spotlight Magazine Winter edition “Scheduling irrigation from space” by Tristan Viscarra Rossel
6. Crop Consultants Australia (CCA) Annual Conference Presentation “IrriSAT - an Irrigation management and crop water use benchmarking system”, 2-3 August, Goondiwindi



**MEDIA MONITORS**



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## The Land 06-May-2010

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# Web irrigation info for Gwydir growers

**C**OTTON irrigators searching for a low-cost method to help their water scheduling in the Gwydir Valley are trialling a phone- or web-messaging service.

Developed by the CSIRO at Griffith as part of a Co-operative Research Centre for Irrigation Futures program, the satellite and SMS Irrigation Water Management Service (IrriSatSMS) is a weather-based irrigation scheduling service.

Satellite imagery determines crop coefficients to calculate crop water requirements and provides customised scheduling information to individual irrigators by SMS messaging or via the internet.

"The main challenge with weather-based scheduling methods is the need for representative evapotranspiration measurements and, most importantly, reliable crop coefficients," said Janelle Montgomery, water technologies team leader with Industry and Investment NSW.

IrriSatSMS is being trialled for the first time in irrigated cotton as part of the NSW Sustaining the Basin: Border Rivers-Gwydir pilot project.

It has been used successfully in the Murrumbidgee Irrigation Area with grape and citrus irrigators and is also under trial in the Hawkesbury-

Nepean catchment.

Two Gwydir Valley consultants undertaking the trial have preferred to use a web interface, so they can communicate with multiple farms with large numbers of irrigated fields.

The consultants, Rob Holmes of HMAg and Nick Gillingham of Sundown Pastoral Company found they could upload information to the service more easily via a website than SMS for individual fields.

The consultants upload information on volumes of water applied and rain received on individual fields to the IrrisatSMS service via a website, which then displays a water balance graph updated in real time.

The Gwydir trial includes two automatic weather stations installed at Weemelah, 30 kilometres east of Mungindi and Keytah, 30km west of Moree.

Both consultants agreed the tool had enormous potential and was another option for irrigation scheduling with the advantage of being low-cost and having wide coverage, as satellite images are available right across Australia.

Mr Holmes said IrriSatSMS won't replace soil probes but the technology had the potential to add value to irrigation scheduling decision mak-

ing.

On the advice of the consultants, researchers are trying to incorporate a forecasting function that predicts crop water requirements for the following five to seven days.

"Irrigators received the technology favourably at a Moree field day recently, so the trial will continue next season to further refine the accuracy and ability of the system to meet cotton growers' needs," Ms Montgomery said.

NSW Sustaining the Basin: Border Rivers-Gwydir is an irrigation modernisation initiative of Industry and Investment NSW in partnership with the Border Rivers-Gwydir Catchment Management Authority, funded by the Australian Government's Water for the Future initiative.

Further information on NSW Sustaining the Basin: Border Rivers-Gwydir can be found at [www.industry.nsw.gov.au/info/sustainingthebasin](http://www.industry.nsw.gov.au/info/sustainingthebasin) and visit [www.environment.gov.au/water](http://www.environment.gov.au/water) for more about the Australian Government's Water for the Future initiative.

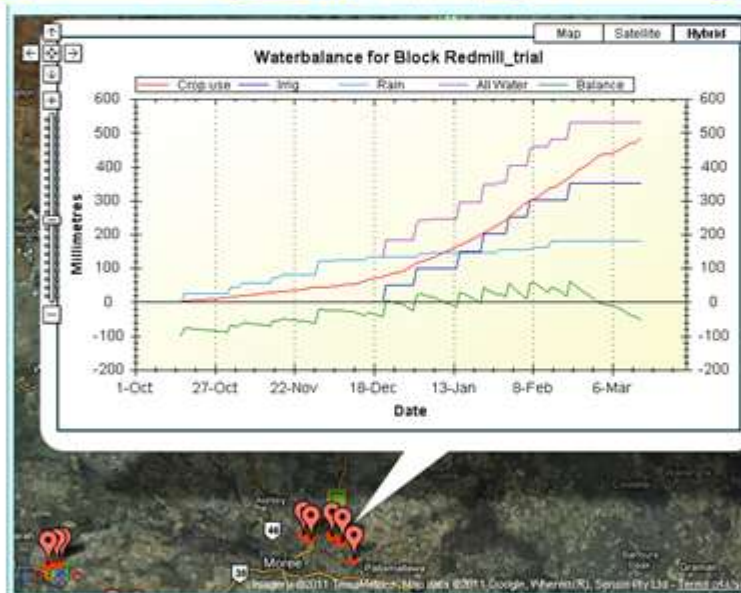
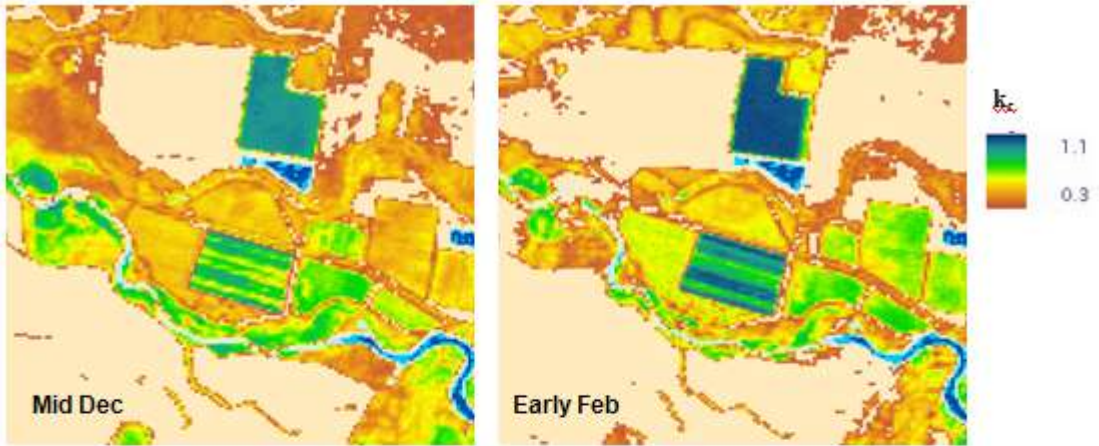
■ Contact Janelle Montgomery, Moree, (02) 6750 6302, or John Hombuckle, Griffith, (02) 6960 1500.



At the recent field day, CSIRO's John Hombuckle shows local irrigators the functions of a weather station

Macintyre Valley Cotton Field Day

Redmill Trial Site - IriSAT



Key Findings/Messages

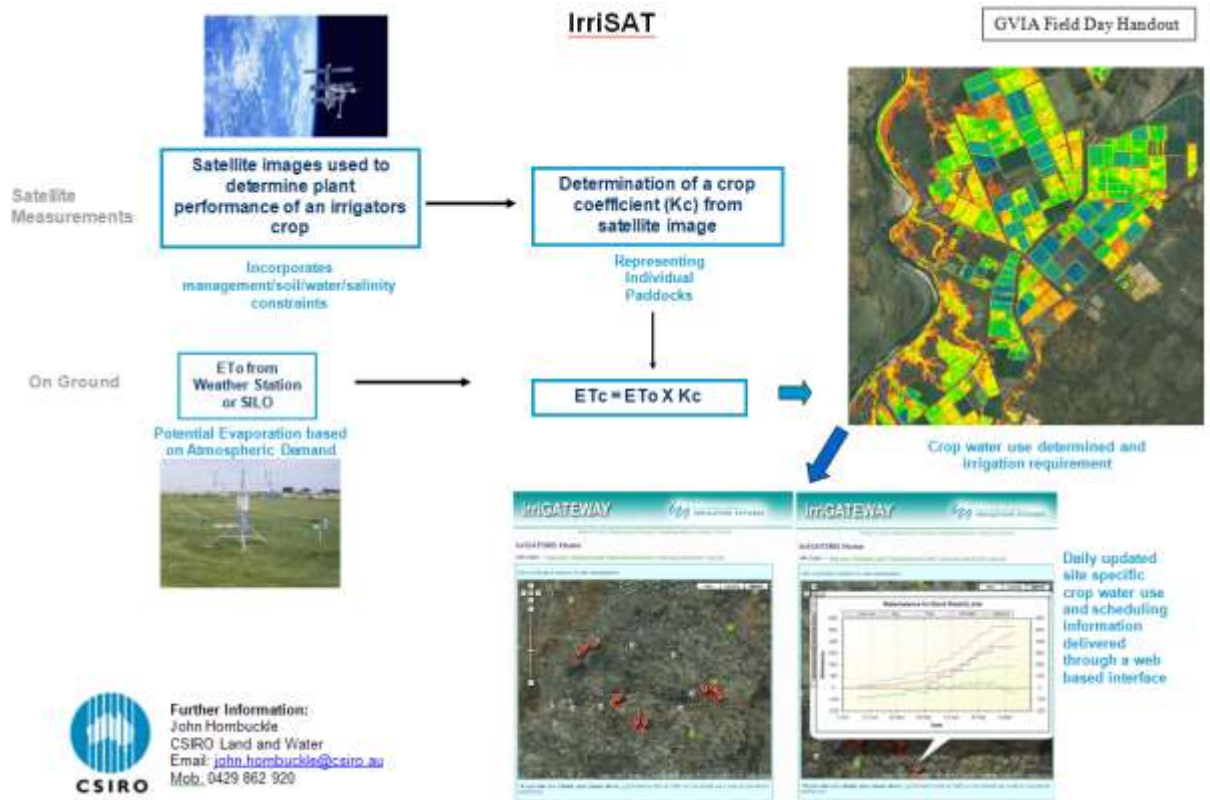
- IriSAT approach is able to differentiate crop water use between different planting and management configurations
- IriSAT approach is able to track plant water use over time and provide site specific information across large areas which can potentially be used in scheduling and benchmarking



Australian Government  
Cotton Research and  
Development Corporation



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Investment



## IAL 2011 Conference Presentation

### Piloting IrriSat technology in Irrigated Cotton

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### Summary

Following the successful use of the service in horticultural industries, IrriSat SMS was trialled for the first time in irrigated cotton. IrriSat SMS uses satellite imagery to better determine site specific crop coefficients that are needed to calculate crop water use. Customised irrigation scheduling information is sent to irrigators by SMS messaging or via a website on the internet. IrriSat is another option within the 'Scheduling Tool Box'.

### Background

Correct irrigation scheduling improves water use efficiency, minimises waterlogging and maximises crop production, however, it can be difficult in Australia because of the variable and unpredictable climate. It is recommended that a variety of tools be used such as visual inspection, soil moisture monitoring and weather based scheduling. While the main scheduling tool used in the cotton industry is soil moisture probes, they are single point measurements. Weather based scheduling methods have not been adopted to the same extent, the main limitation being the need for a representative evapotranspiration (ET<sub>0</sub>) measurement and site specific crop coefficients.



Developed by CSIRO, IrriSat SMS is a weather based irrigation scheduling service. It uses satellite imagery to better determine crop coefficients that are site specific for individual irrigators which are then combined with reference evapotranspiration to calculate crop water use (Hornbuckle et al. 2009). It also provides customised irrigation scheduling information which is sent to irrigators by SMS messaging or via a website on the internet.

## The Story

Following the successful use of the IrriSat SMS service in the Murrumbidgee Irrigation Area with grape and citrus irrigators, it was trialled for the first time in irrigated cotton in the Gwydir valley in northern NSW during the 2009/10 cotton season by two cotton consultants. This trial was extended to include 10 cotton consultants located in the Gwydir and Border Rivers region during the 2010/11 season.

The IrriSat service involves the installation of a network of 2 to 4 weather stations across the area so reliable estimates of ETo can be obtained. Satellite images are used to frequently determine crop coefficients for individual fields over the entire growing season. These satellite images show different vegetative growth stages of the crops growing in the region which can be directly related to a site specific crop coefficient.

Researchers have found a strong relationship between Normalized Difference Vegetation Index (NDVI) and crop canopy cover (Hornbuckle et al. 2010). Canopy cover is a direct driver of crop water, allowing a clear relationship to be developed between NDVI values and crop coefficients. This relationship has been found in a large range of crops, however this is the first time the relationship has been established for broad acre irrigated cotton in Australia.

Therefore, once the NDVI data has been derived for a particular crop and field, it is then converted to a Kc value and used to determine crop water use by combining Kc with the ETo data collected from a nearby weather station.

## Analysis and commentary

The consultants involved in the trial have provided valuable feedback to CSIRO researchers on how the technology could be best utilised in the cotton industry. The first change came at the beginning of the 2009/10 season when both consultants asked that the information be provided on a web interface rather than via text message. In order to meet this need a web based interface was developed in Google maps which allowed consultants to monitor multiple fields, with individual consultants during the trial monitoring up to 50 separate fields across an irrigation region.

This was a key change for the provision of IrriSat reflecting the fact that cotton consultants work on multiple farms with large numbers of irrigated fields across a wide region.

Although irrigation information can be uploaded to the service much easier via a web site, rather than sending and receiving SMS information for individual fields, the consultants are requesting a quicker way to upload irrigation data, such as the ability for the technology to “talk” to data loggers already in use on farm for irrigation information and rainfall.

Further changes have included a forecasting ability to predict crop water use for the coming 7 days and provision of daily crop water use values presented in tables as well as graphically.

## Lessons learned

2010/11 season was one of Australia’s largest cotton production years on record resulting in an extremely busy season for the participating consultants. Issues identified by the trial participants were that the time required by consultants to upload irrigation information was a barrier to the adoption of this technology and, where possible, new ways of automating data input should be investigated. The season has provided significant information regarding the accuracy of the technology (ground-truthing) and the consultants have identified the usefulness of the tool for

looking retrospectively over the irrigation season to see how effective and efficient irrigation decisions were.

The consultants agree that the tool has enormous potential. Although it would not replace soil probes, they thought the technology has the potential to add value to irrigation scheduling decision making

## Conclusions

IrriSat is seen as another option within the 'Scheduling Tool Box' but with the advantage of low cost and wide coverage as the satellite images are available right across Australia.

The technology has been proven to provide useful irrigation water management information in a number of irrigated cropping commodities across Australia. This recent research has shown the IrriSat approach provides useful information at a range of time and spatial scales across irrigated cotton enterprises. Further work now needs to be undertaken to integrate and automate the approach for the cotton industry.

The authors would like to gratefully acknowledge the assistance provided by CRDC in funding this research and the consultants who took part in the trial.

## References

- Hornbuckle, J.W., Car, N.J., Christen, E.W., Stein, T.M. and Williamson, B. (2009). IrriSatSMS - Irrigation water management by satellite and SMS - A utilisation framework. CRC for Irrigation Futures Technical Report No. 01/09 and CSIRO Land and Water Science Report No. 04/09. [http://www.irrigateway.net/publications/irrisatsms\\_v\\_60\\_finalwAppendix.pdf](http://www.irrigateway.net/publications/irrisatsms_v_60_finalwAppendix.pdf)
- Hornbuckle, J., Christen, E., Car, N. & Smith, D. (2010) Convenient and low cost irrigation scheduling – an opportunity for irrigators, Australian irrigation Conference 2010, Darling Harbour Sydney, 8-11th June 2010

B. Have you developed any online resources and what is the website address?

Links of Interest which have been developed out of this project are:

Real time ETo information and 7 day ETo forecast information for the Gwydir is available from <http://weather.irrigateway.net/>

Crop coefficient maps updated from satellite imagery for the major cotton growing areas of Australia are available from <http://www.irrigateway.net/tools/kcmap/>

General information on IrriSAT and a suite of products related to irrigation management are available from <http://www.irrigateway.net/>

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## ***Part 4 – Final Report Executive Summary***

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Provide a one page Summary of your research that is not commercial in confidence, and that can be published on the World Wide Web. Explain the main outcomes of the research and provide contact details for more information. It is important that the Executive Summary



highlights concisely the key outputs from the project and, when they are adopted, what this will mean to the cotton industry.

Water management in the cotton industry has continued to be of fundamental importance to sustainability and production. Dealing with climate variability that requires the tools of water management be more sensitive to atmospheric factors. The IrriSAT suite of tools integrate atmospheric measurements with plant vigour measurements, creating tools which reflect very well the current climate, including extremes and spatial variability in crops.

The IrriSAT tools capture a foundation dataset for the reporting and management of variability of plant water use. IrriSAT is a weather based irrigation scheduling service. It uses satellite imagery to better determine crop coefficients that are needed to calculate crop water use. The system uses on-ground weather stations to measure sunlight hours and intensity, cloud cover, rainfall and wind which are all used to calculate a potential water use in the past 24 hours. This information when combined with the satellite-determined crop coefficient for a particular crop allows an actual water use figure to be calculated on a site specific basis for low cost.

During the 2010/2011 irrigation season an initial trial was undertaken to assess the potential of the IrriSAT system for use in water management in cotton production systems. Ten consultants took part in the trial with 304 individual paddocks or blocks being monitored. Total area monitored was approximately 20 000 ha.

Based on the results of the trials and feedback received from the trial participants there were three potential applications of the IrriSAT technology identified and initially assessed for their useability and function which could benefit the cotton industry. These are:

1. Providing site specific irrigation scheduling information
2. Regional water use benchmarking
3. In season yield forecasting

Each one of these components has clear benefits for the cotton industry. From this initial trial it was clear that there is significant interest in the approach by water managers in the cotton industry and real benefits for water management.