GVIA

Gwydir Valley Irrigators Association Inc.

Grower Led Irrigation System Research in the Gwydir Valley

System Comparison Trial 2009 - 2016

The 2015-2016 season was the fourth for the grower-led irrigation system comparison trial in the Gwydir Valley. The trial has been co-ordinated by the Gwydir Valley Irrigators Association (GVIA) in partnership with Sundown Pastoral Company. It was initiated at Keytah in 2009 and has run every second year since.

The trial aims to provide growers commercial comparisons of the yield and water use efficiency of four different irrigation systems in use in the Australian cotton industry.

The systems included are;

- Furrow Siphon,
- Lateral Move,
- Subsurface Drip and
- Bankless Channel.

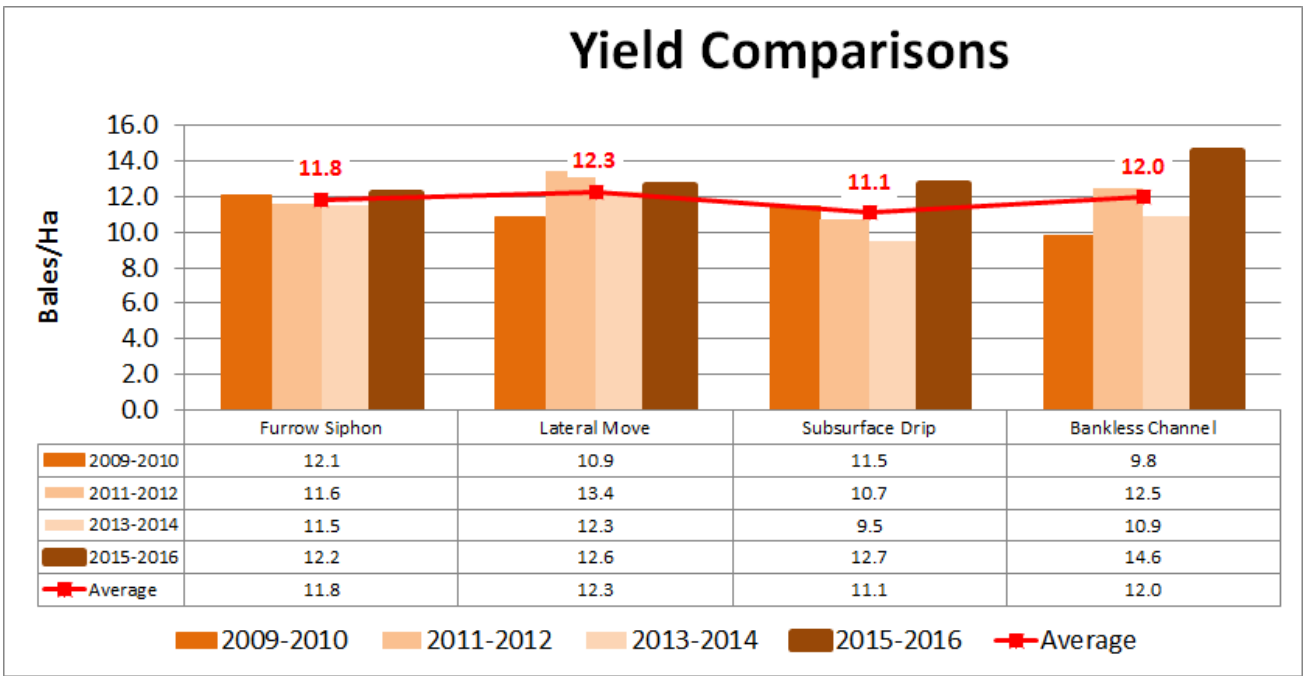
To improve the usefullness of the data, additional information has been collected on the relative energy and labour resource requirements of each system. This information will help producers make better irrigation infrustructure investment decisions.

Key Results

- The Lateral Move produced the highest average yield of 12.29 bales/Ha and highest average GPWUI of 1.3 bales/ML.
- The Furrow Siphon was the most consistent yielding system with an average of 11.84 bales/Ha.
- The Bankless Channel had an average yield of 11.95 bales/Ha.
- The Drip had an average yield of 11.12 bales/Ha.
- The Furrow Siphon has high labour costs, but low operating energy costs.
- The Lateral Move and Subsurface Drip have high operating energy costs.
- The Lateral Move and Subsurface Drip have high capital costs.
- The Bankless Channel had the lowest total operating cost and the lowest operating, maintenance and ownership costs.

System Comparison Yield and Water Use Efficiency

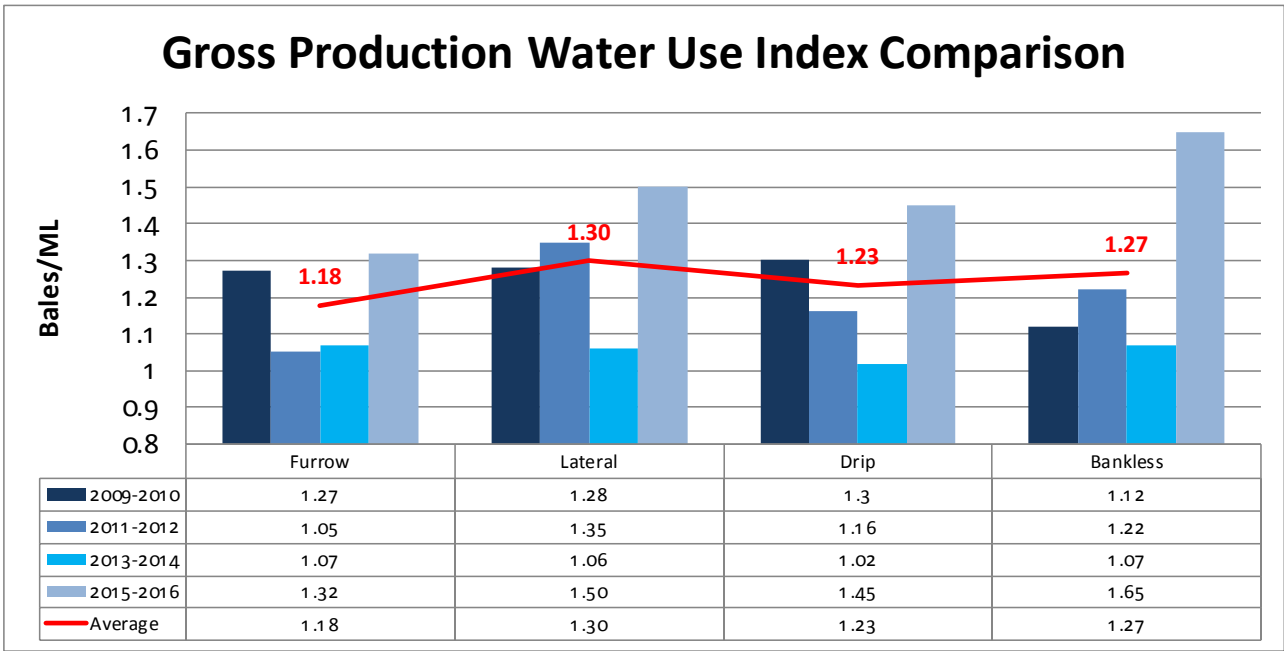
The comparison trial has been run in four quite different seasons; 2009-2010 was more of a typical season, 2011-2012 was a wet year with two flood events, 2013-2014 was a hot dry season with very little in-crop rainfall, and 2015-2016 was dryer, with no effective rainfall after mid-January. The 2015-2016 crop was planted on limited water, and received it's last irrigation in early February.



	Furrow Siphon	Lateral Move	Subsurface Drip	Bankless Channel
2009-2010	12.1	10.9	11.5	9.8
2011-2012	11.6	13.4	10.7	12.5
2013-2014	11.5	12.3	9.5	10.9
2015-2016	12.2	12.6	12.7	14.6
Average	11.8	12.3	11.1	12.0

The yield comparison graph above shows the four year average and the seasonal yields for each system. Over the four years the lateral move produced the highest average yield of 12.29 bales per hectare. The furrow siphon however has demonstrated the most consistency in yield over the four seasons, ranging from 12.2 to 11.5 bales per hectare.

The Gross Production Water Use Index (GPWUI) shown below, combines total seasonal water use with soil moisture and yield. The higher the GPWUI the more water efficient the crop. The lateral move has the highest average GPWUI of 1.3 bales/ML. This data clearly demonstrates the variations commonly found between seasons. The lateral move performed strongly in the wet year, while the two flood irrigation systems were strongest in the hotter dry season where there was little in-crop rainfall. This suggests that there is no system perfectly suited to all seasons.



	Furrow	Lateral	Drip	Bankless
2009-2010	1.27	1.28	1.3	1.12
2011-2012	1.05	1.35	1.16	1.22
2013-2014	1.07	1.06	1.02	1.07
2015-2016	1.32	1.50	1.45	1.65
Average	1.18	1.30	1.23	1.27

System Comparison Labour, Energy and Operating Costs

The high labour requirements of the furrow siphon system is one of the main disadvantages of the system (chart 1). Labour however, is only one of the resources growers need to consider; energy requirements are also critical. Chart 2 shows operating energy costs, the lateral move and subsurface drip systems require significantly more fuel per megalitre per hectare than either the furrow siphon or bankless channel. This energy demand is principally due to the need to pressurise water in both lateral move or subsurface drip systems.

Chart 1

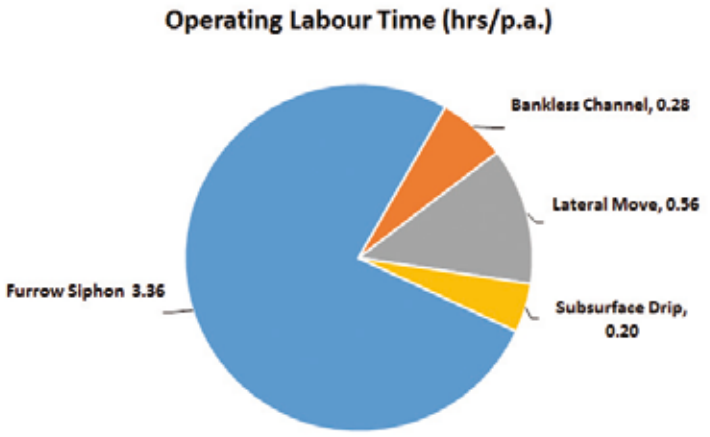
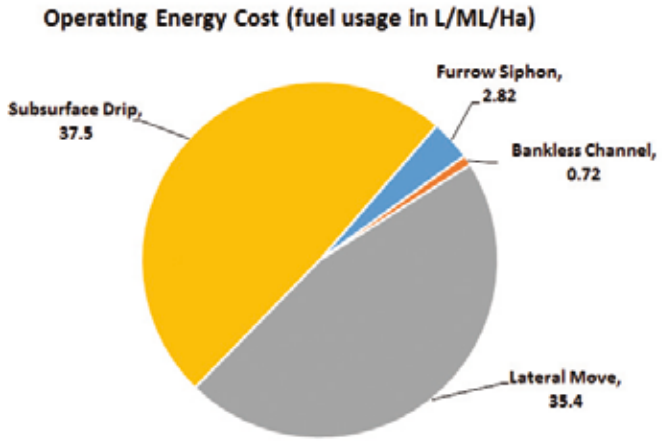


Chart 2



The total operating cost per hectare per annum (chart 3), clearly shows that the combination of labour and energy costs mean that the furrow siphon, lateral move and subsurface drip all have significantly higher operating costs than the bankless channel. The bankless channel can be effectively run with minimal staff and there is no requirement to pressurise water.

Chart 3

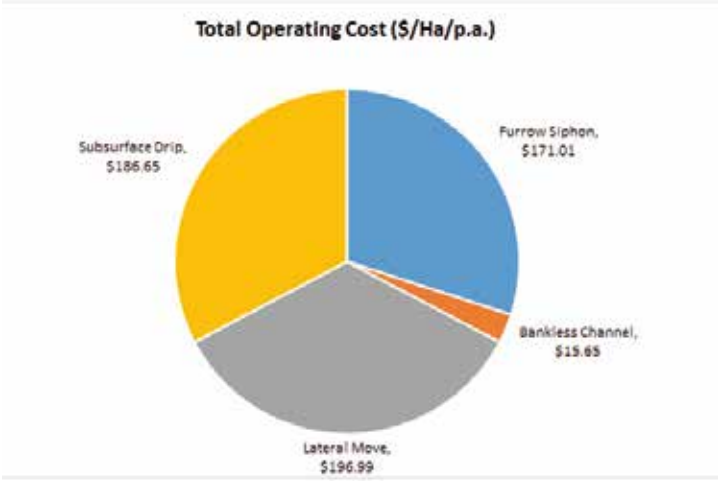
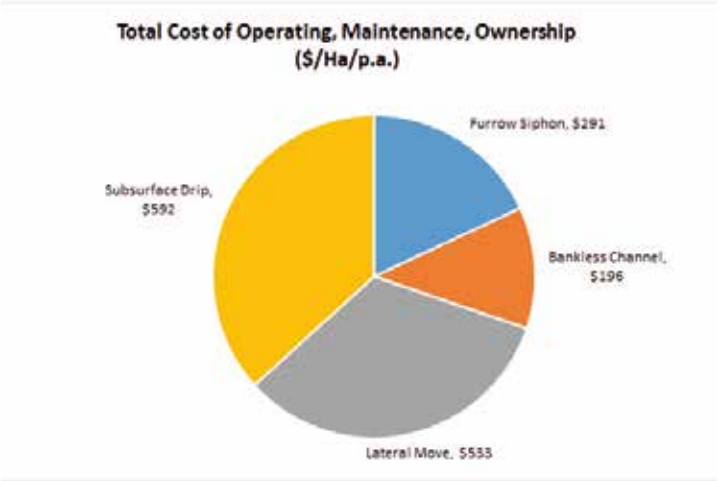


Chart 4



Infrustructure and field maintenance, capital setup cost and depreciation all contribute to the total cost of the system (chart 4). In recent years the repairs and maintenance on the lateral move have been noticablly more than for the other systems. It was also necessary to re-level the bankless channel field prior to the 2015-2016 season.

Both the lateral move ($3,880) and the subsurface drip ($8,500) were significantly more costly to establish. This cost needs to be spread as a fixed cost across the life of the system, which has the potential to make these systems less suitable in areas where the reliability of irrigation water is low.

Furrow/Siphon Irrigation

Seasonal Statistics:	2009-2010	2011-2012	2013-2014	2015-2016
Establishment method:	Watered up	Rain Moisture	Watered up	Watered up
Planting:	7th Oct 2009	14th Oct 2011	7th Oct 2013	19th Oct 2015
Number of irrigations:	7	6	10	7
Irrigation water applied/ Ha:	5.22 ML/Ha	6.14 ML/Ha	8.57 ML/Ha	6.91 ML/Ha
Total seasonal water use:	9.50 ML/Ha	13.46 ML/Ha	11.37 ML/ha	10.04 ML/Ha
Gross Production Water Index:	1.27 Bales/ML	1.05 Bales/ML	1.10 Bales/ML	1.32 Bales/ML
Picking:	27th April 2010	15th May 2012	29th May 2014	13th April 2016
Yield:	12.06 Bales/Ha	11.60 Bales/Ha	11.46 Bales/ha	12.2 Bales/Ha

The furrow siphon system is presently the most widely utilised system in the industry. The data from this trial has confirmed that this is an efficient system which has consistently produced good yields in all seasons. It is reliable and well understood.

The benefits of the furrow siphon include:

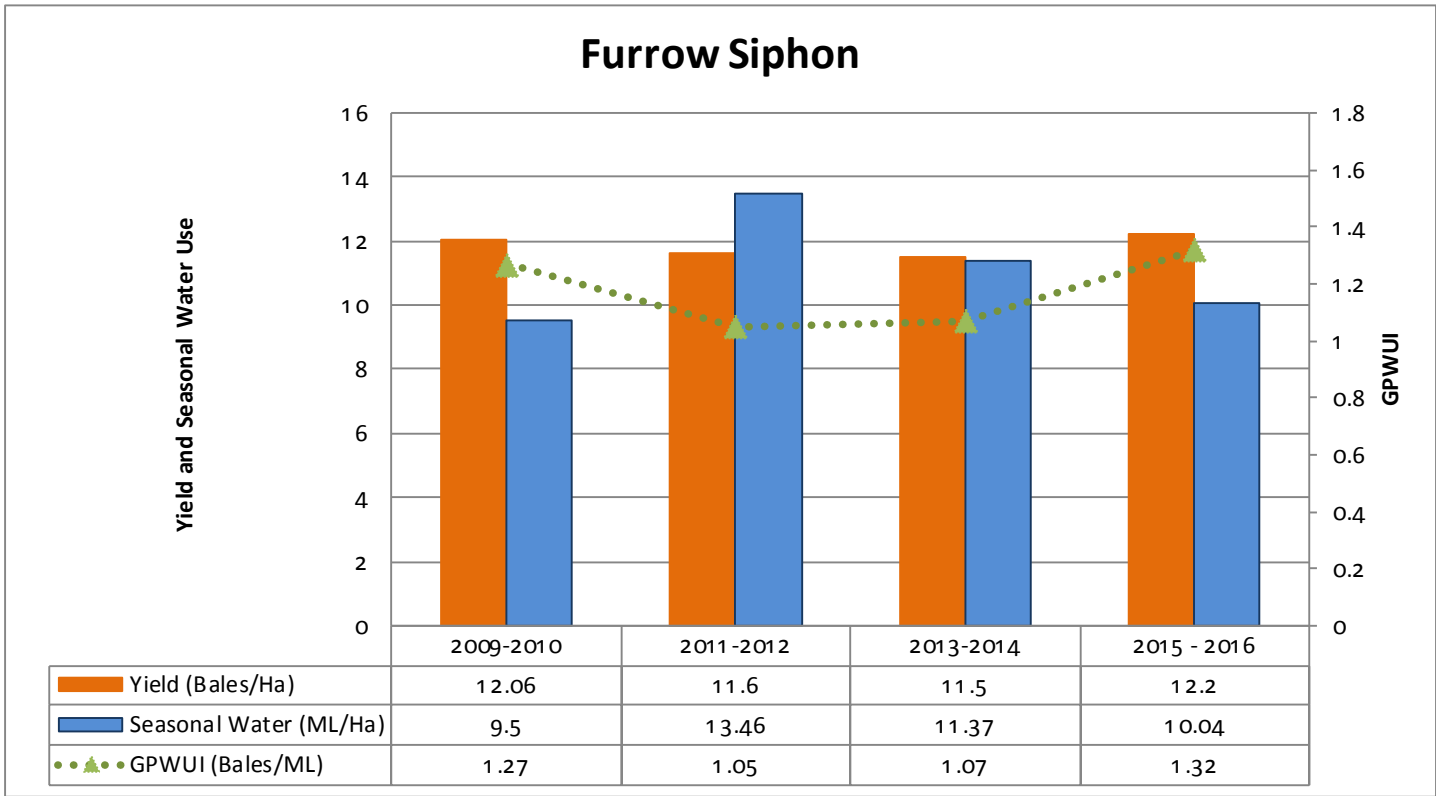
- The low operating energy costs.
- The lower maintenance and capital set up costs and
- Consistent yield.

The disadvantages of furrow siphon include:

- A high labour resource requirement and
- Greater volumes of tail water.

Furrow Siphon Summary

- Consistent yield,
- Average yield of 11.84 bales/Ha
- Average GPWUI of 1.18 bales/ML
- Average of $134/Ha/annum.
- Total operating cost of $171/Ha/annum
- Capital setup costs of $1,000/Ha
- Total cost of operation, maintanance and ownership $291/Ha/annum.



Lateral Move

Seasonal Statistics:	2009-2010	2011-2012	2013-2014	2015-2016
Establishment method:	Watered up	Rain Moisture	Pre Irrigated	0.6 ML Pre Irrigation
Planting:	1st Oct 2009	14th Oct 2011	10th Oct 2013	20th Oct 2015
Number of irrigations:	10	10	19	14
Irrigation water applied/ Ha:	3.90 ML/Ha	4.32 ML/Ha	8.34 ML/Ha	4.85 ML/Ha
Total seasonal water use:	8.46 ML/Ha	11.79 ML/Ha	12.65 ML/ha	8.04 ML/Ha
Gross Production Water Index:	1.28 Bales/ML	1.35 Bales/ML	1.04 Bales/ML	1.5 Bales/ML
Picking:	3rd May 2010	15th May 2012	22nd May 2014	19th April 2016
Yield:	10.86 Bales/Ha	13.40 Bales/Ha	12.26 Bales/Ha	12.6 Bales/Ha

The lateral system has performed well, producing the highest average yield and GPWUI.

The benefits of the lateral system include;

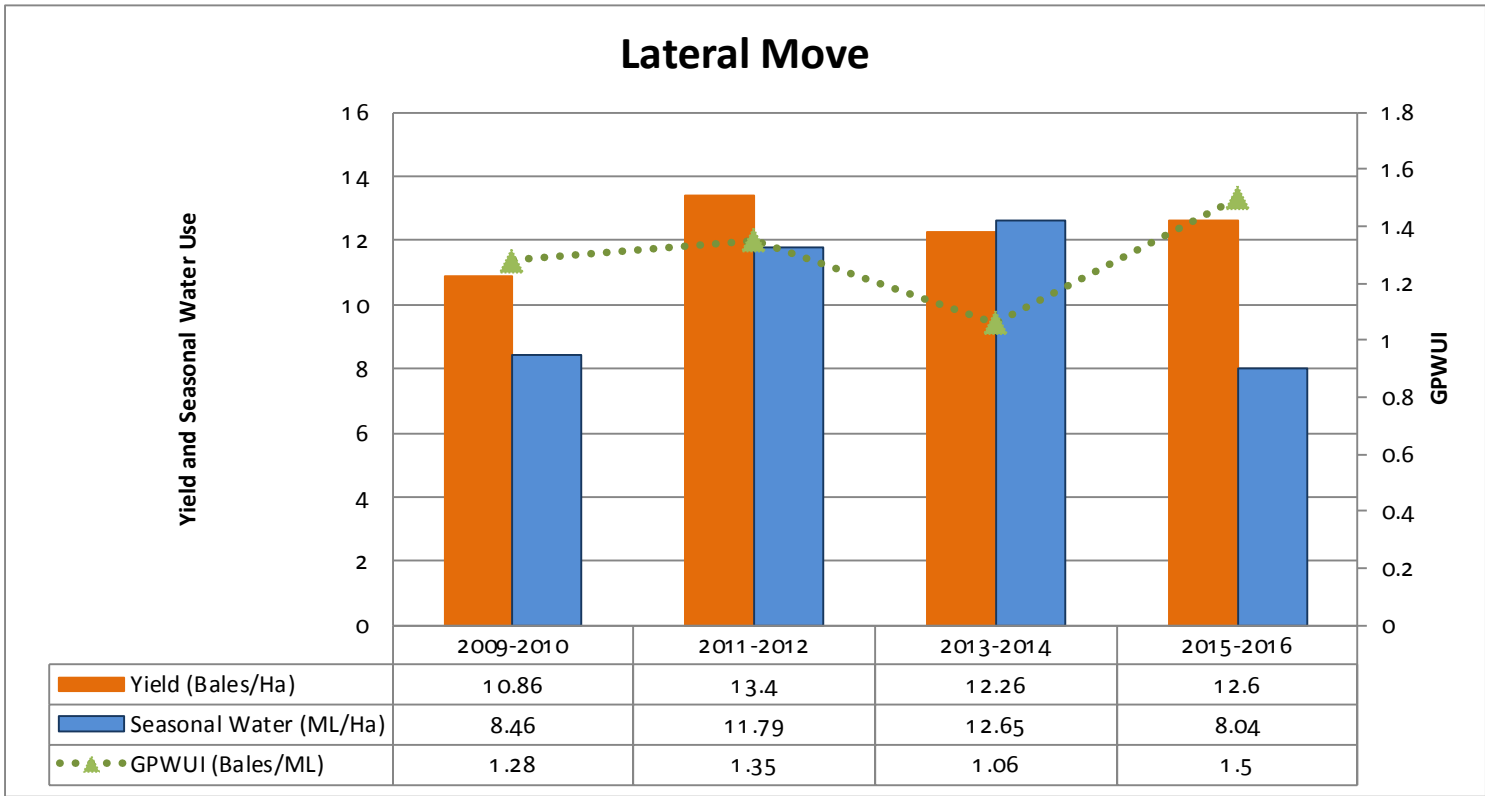
- More precise irrigation to take advantage of in-crop rainfall and avoid water logging during extreme events.

The disadvantages of the lateral include;

- The high operating energy costs.
- The high cost associated with maintenance, capital set up and depreciation.
- Potential difficulty in maintaining water in a hot dry season.
- Higher labour skills to efficiently manage the system.

Lateral Move Summary

- Highest average yield of 12.29 bales/Ha,
- Best average GPWUI 1.30 bales/ML,
- Reduced requirement for labour.
- Operating fuel costs of $175/Ha/annum,
- Total operating cost of $197/Ha/annum,
- Capital setup costs of $3,880/Ha
- Total cost of operation, maintanance and ownership $533/Ha/annum



Subsurface Drip

Seasonal Statistics:	2009-2010	2011-2012	2013-2014	2015-2016
Establishment method:	Watered up	Rain Moisture	Watered up	Watered up
Planting:	1st Oct 2009	14th Oct 2011	7th Oct 2013	20th Oct 2015
Number of irrigations:	15	12	16	12
Irrigation water applied/Ha:	4.14 ML/Ha	3.80 ML/Ha	6.96 ML/Ha	5.58 ML/Ha
Total seasonal water use:	8.80 ML/Ha	11.42 ML/Ha	9.84 ML/ha	8.77 ML/Ha
Gross Production Water Index:	1.30 Bales/ML	1.16 Bales/ML	1.05 Bales/ML	1.5 Bales/ML
Picking:	22nd April 2010	15th May 2012	22nd May 2014	19th April 2016
Yield:	11.46 Bales/Ha	10.70 Bales/Ha	9.52 Bales/ha	12.8 Bales/Ha

The subsurface drip system has produced good water use efficiency, but has an average yield below the other systems.

The benefits of the drip system include;

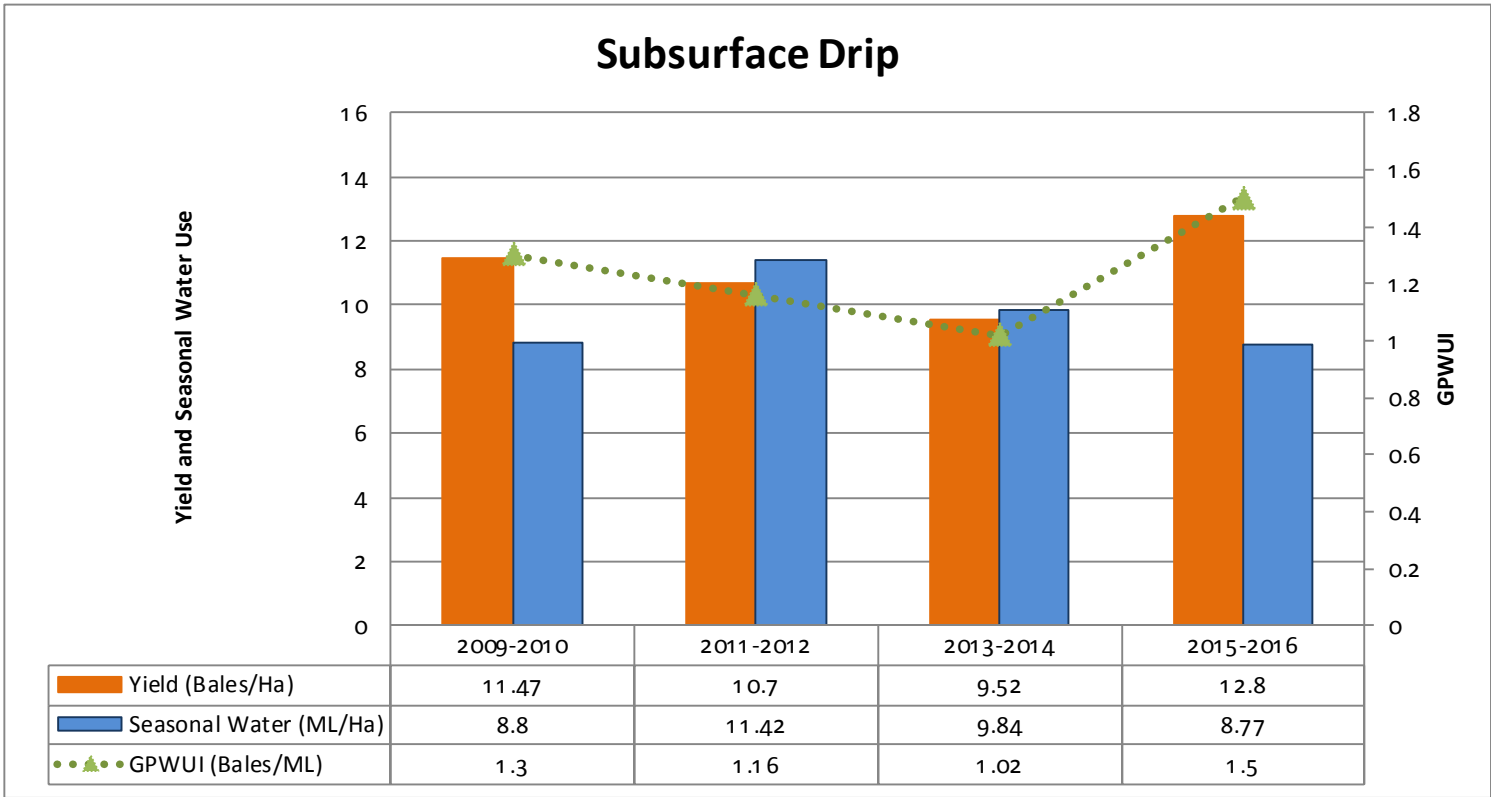
- It is the most water efficient.
- Reduced labour resource requirements and
- Has the potential be automated.

The disadvantages of the drip system include;

- High capital setup costs and
- High operation costs as a result of high energy requirements.

Subsurface Drip Summary

- Average yield of 11.12 bales/Ha
- Average GPWUI of 1.23 bales/ML,
- Operating fuel costs $179/Ha/annum
- Total Operating cost of $187/Ha/annum
- Capital setup costs of $8,500/Ha
- Total cost of operation, maintanance and ownership $592/Ha/annum.



Bankless Channel

Seasonal Statistics:	2009-2010	2011-2012	2013-2014	2015-2016
Establishment method:	Watered up	Rain Moisture	Pre-Irrigated	Watered-up
Planting:	Re-sown 12th Oct 2009	14th Oct 2011	8th Oct 2013	20th Oct 2015
Number of irrigations:	6	5	11	5
Irrigation water applied/ Ha:	4.89 ML/Ha	5.22 ML/Ha	7.90 ML/Ha	6.06 ML/Ha
Total seasonal water use:	8.78 ML/Ha	12.51 ML/Ha	10.95 ML/ha	9.25 ML/Ha
Gross Production Water Index:	1.12 Bales/ML	1.22 Bales/ML	1.10 Bales/ML	1.67 Bales/ML
Picking:	22nd April 2010	15th May 2012	11th May 2014	18th April 2016
Yield:	9.80 Bales/Ha	12.50 Bales/Ha	10.93 Bales/ha	14.6 Bales/Ha

The bankless channel system was set up just before planting in 2009. which impacted the 2009-2010 results

The benefits of the bankless channel include;

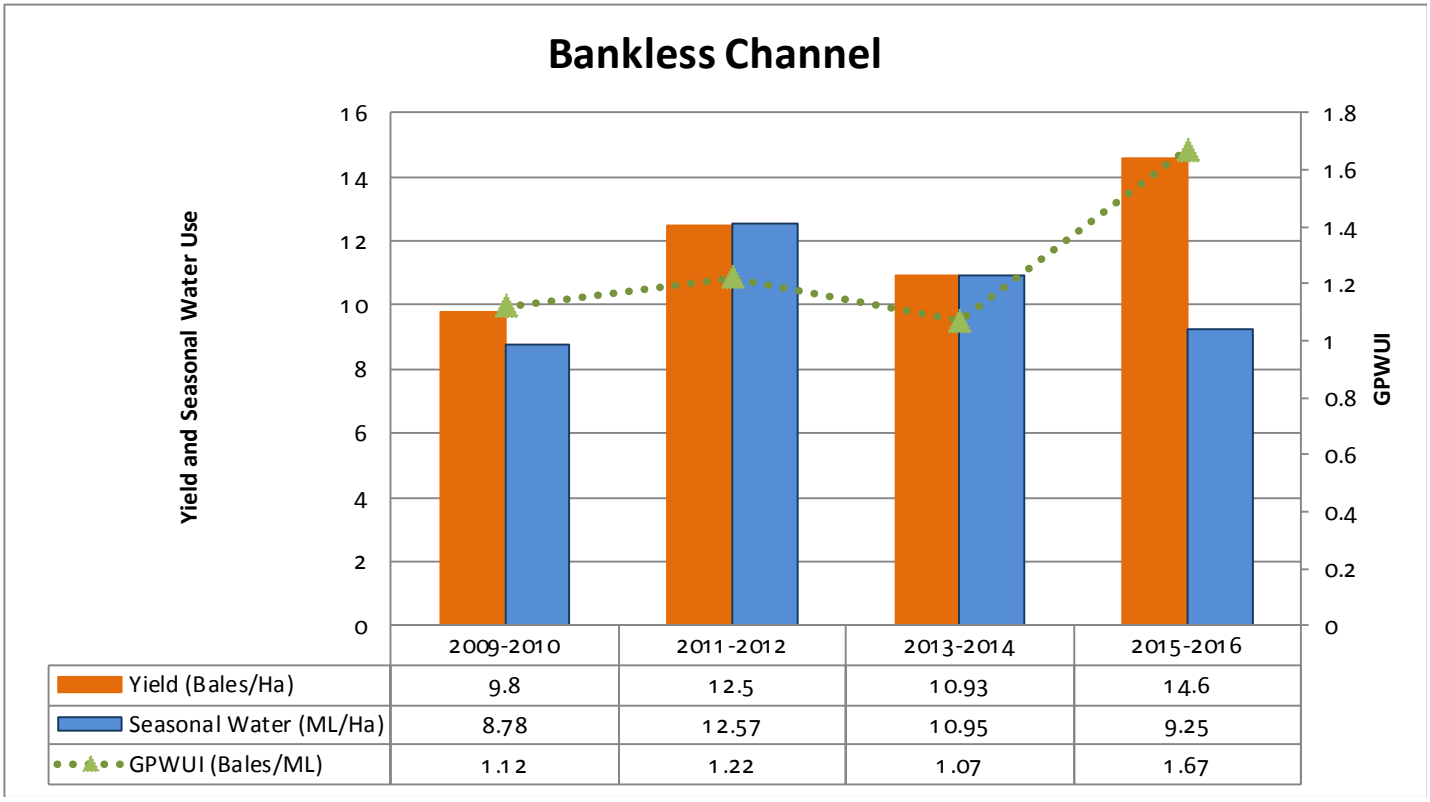
- Labour savings and ease of management.
- Minimal tail water.
- Low energy, maintenance and capital setup costs.

The disadvantage of Bankless Channel is;

- Field development. Large volumes of soil could potentially need to be removed which can have long term impacts on production potential.

Bankless Channel Summary

- Average yield of 11.95 bales/Ha
- Average GPWUI of 1.27 bales/ML
- Total Operating cost of $16/Ha/annum
- Capital setup costs of $1,250/Ha
- Total cost of operation, maintanance and ownership $196/Ha/annum.



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making every drop count

Which System is right for you?

The performance of each of the systems will vary with the seasonal conditions. They all have benefits and limitations which will impact suitability on a farm by farm basis.

Furrow Siphon:

The furrow siphon system was relatively efficient and produced consistent yields in all seasons. It has high labour resource requirements and the trial has indicated that there may be up to 30 percent more tail water than the other systems.

Lateral Move:

The lateral move has the potential to produce good yields and water use efficiency, especially if you are in a high rainfall environment. Maintaining good water use efficiency in hot dry conditions can however be more difficult.

The lateral move system relies on pressurising water, which increases the operating energy costs. It requires significant up-front capital investment and there are ongoing maintenance costs. This needs to be balanced with the potential water savings and reduced requirement for labour. Good water reliability would increase the suitability of the Lateral Move.

Subsurface Drip:

The subsurface drip is the most water use efficient although the yield performance has been less than the other systems. It shows potential as it is ideally suited to being fully automated.

There are large capital investment costs associated with drip irrigation. Investment decisions need to balance capital costs, operating energy costs and water savings.

Bankless Channel:

The bankless channel has been a standout system as far as ease of watering and labour saving. There are minimal operating energy costs as well as good yield and water use efficiency with this system.

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Australian Government
Cotton Research and Development Corporation

Australian Government
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