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Sustaining The Basin Irrigated Farm Modernisation

Case Studies in Irrigation Infrastructure Improvement

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Cover image: STBIFM funded centre pivot installed at Boggabri, NSW.

Introduction

The Sustaining the Basin Irrigated Farm Modernisation (STBIFM) program has invested a total of $99 million in infrastructure improvements on irrigation farms in the Northern NSW Murray Darling Basin, with $77 million funded by the Australian Government through the NSW Department of Primary Industries and a further $22 million invested by our irrigator partners.

The case studies featured in this booklet offer a snapshot of key water efficiency technologies implemented through the program from 2012 to 2019 and the economic and social benefits that have flowed through to irrigation farmers and rural towns and communities.

Irrigation improvements funded by STBIFM have recovered water savings totalling 33.9 gigalitres. Approximately two thirds (23.3 gigalitres) of these savings have been transferred as water entitlement to the Commonwealth for the environment, while the remaining 10.6 gigalitres has been kept on-farm to boost agricultural production.

In the words of project partner, Richard Schwager, from Wee Waa in Northern NSW, "Strong farms mean strong towns. The STBIFM program has helped to keep farmers and rural communities viable."

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Overhead Irrigation (CPLM)

Switching to overhead irrigation was a popular farm modernisation choice amongst STBIFM irrigator partners. One third of all STBIFM projects included the installation of overhead irrigation systems.

Centre Pivot and Lateral Move (CPLM) overhead irrigation technology can substantially improve water use efficiency (the amount of profit/production compared to the amount of water applied).

The benefits of CPLM technology are very evident when irrigation water allocations are low. Compared to siphon fed irrigation, overhead systems give greater control over when and how much water is applied to a crop, resulting in substantial water savings in the early stages of growth and allowing irrigation applications to be immediately reduced when rain provides unexpected extra moisture.

STBIFM project partners report that CPLM technology is particularly useful in enabling the application of small amounts of extra water to high value winter crops, whereas small amounts of water can't be applied efficiently using a siphon fed surface irrigation system. More precise timing of irrigation has also been shown to increase crop yields.

STBIFM funding allowed the Quigley family at Nevertire in Western NSW to redesign and redevelop their water supply and drainage systems, and to reshape their fields to improve the effectiveness of overhead irrigation.

"When we relied purely on furrow irrigation, our operations were effectively a stranded asset during dry years," said **Tom Quigley**.

"Now it's no longer an all-or-nothing proposition. When we have low allocations, the infrastructure improvements and overhead irrigation give us the flexibility to focus on winter crops like chickpeas, canola and wheat. They only need a small amount of supplementary water to dramatically lift yields and profitability."

Funding from the STBIFM program helped Tony and Tom Quigley modernise their irrigation infrastructure.

Thirsty for knowledge, irrigation farmers inspect a centre pivot machine during an STBIFM funded field day at the Barlows' Mirrabinda property at Gunnedah.

The Barlow family at Boggabri took advantage of STBIFM funding to convert almost all of their surface irrigation fields (630 ha) to automated centre pivot irrigation.

Nine centre pivots were installed, including one towable machine, ranging in size from 300 to 440 metres in length.

The modernised infrastructure has resulted in improved water use efficiency and increased productivity. According to **James Barlow**, the benefits of centre pivot technology also include lower energy and labour costs, and more successful crop establishment.

Drip Irrigation

Conversion from siphon fed furrow irrigation to drip can substantially increase water use efficiency. Unlike siphon fed irrigation, drip systems allow more precise control over the amount of water applied to crops and can reduce seepage and evaporation. Applying just the right amount of water at the right time in the growth cycle of a crop can also improve crop yields. Automation of drip systems can further reduce labour costs and other farm overheads.

Crawford Ag:

25% **lift** in yield

30-40% **water** savings

Stewart Crawford reports the conversion to drip irrigation on his free draining soil type has resulted in water savings of 30-40%, while he has seen a lift in crop yield of at least 25%.

Stewart cautions that investment in drip systems is expensive, but the investment is economically viable on his property because of a reliable bore water supply.

Irrigation station housing pumps and electronic control panel for the drip system on the Crawford property, Bungarley.

Narromine farmer Stewart Crawford understood the benefits of drip in terms of water savings and higher crop yields, having already developed 175 hectares of drip irrigation prior to partnering with STBIFM.

With financial assistance from STBIFM funding rounds in 2012 and 2013, Stewart converted an additional 135 hectares to sub-surface drip irrigation.

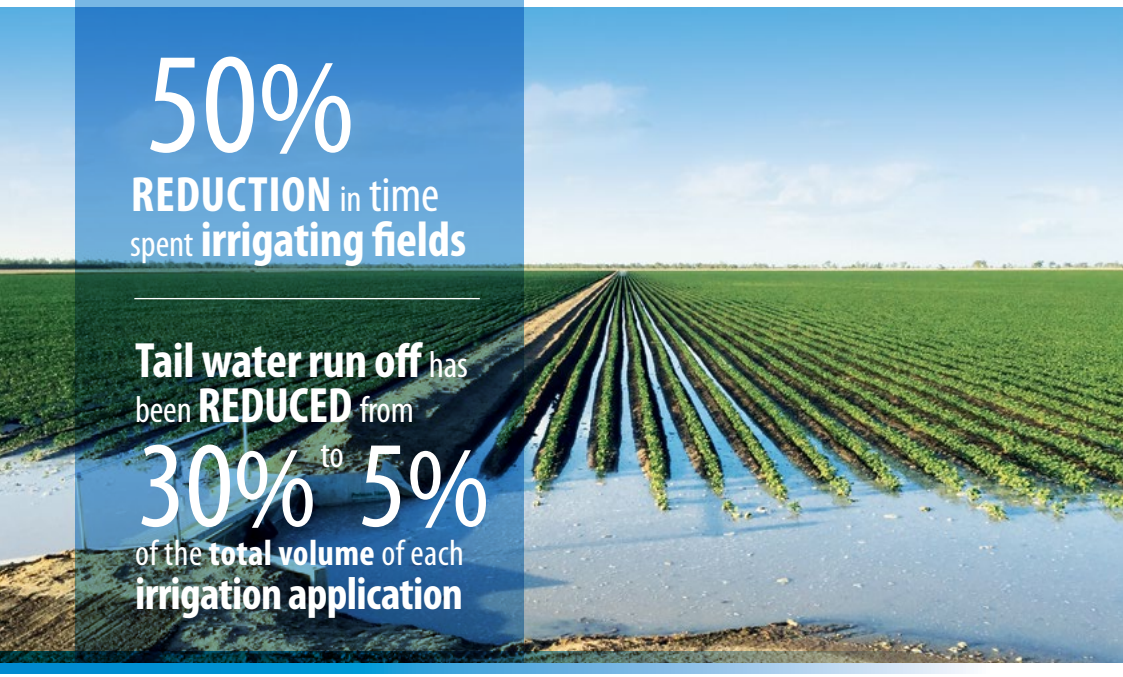
His STBIFM funded projects are estimated to have saved 296 ML of water previously lost to evaporation and seepage. Seventy five percent of that water saving has been permanently transferred to the Commonwealth Environmental Water Holder to improve the health of the Murray Darling.

Stewart's sub surface drip system can be controlled remotely from his smart phone. Drip irrigation has also given him greater flexibility to grow high value crops and has improved the structure of his sandy loam soils, reducing water logging and erosion.

Rising energy prices were a critical issue during the design phase of this STBIFM project. "The biggest part of driving a pressurised drip system is fuel. With this design we've tried to focus totally on low energy use," said Stewart.

"We had experience with sub-surface drip so we knew what we wanted and in some ways it was a bit easier for us, but I would encourage other irrigators with no experience to get advice from a couple of sources. Ask existing growers as well as the retailers."

Cotton crop watered by sub surface drip irrigation.



Bankless Channels

Bankless channel irrigation enables water to be applied and removed from fields more quickly than traditional siphon irrigation and creates opportunities for considerable labour, water and energy savings.

Traditional furrow irrigation requires a pipe to be placed at the top of each one to two furrows in the irrigation field to siphon water from the supply channel. There can be more than 100 furrows in a field, and each siphon has to be manually started and stopped for every watering.

In contrast, bankless channel systems incorporate a supply channel that, when filled, overflows into the first bay of the adjacent field, simultaneously filling all the furrows in that bay. Once each bay has been irrigated, an outlet in the supply channel is opened allowing both supply and excess drainage water to drop into the next bay.

STBIFM funding transformed **Bill and Lucy Ferguson**'s irrigation operations at Trangie in the Macquarie Catchment.

The Fergusons converted a siphon fed operation to a bankless channel system, halving the time it takes to irrigate their fields. They report the bankless system also uses less water and has reduced water logging in the crop.

Managing runoff from fields had been a time consuming process and around 30% of the water applied had to be recycled. Across a seven day cycle this meant almost continuous pumping. With the implementation of bankless channel infrastructure, tail water has been reduced to just 5% of the original volume of water applied to crops.

Other benefits of the bankless system are that water moves off fields more efficiently and the tail drains are wet for a shorter period. This reduces deep drainage losses with less water moving below the root-zone beyond the reach of the growing crop.

STBIFM provided the catalyst for the Fergusons to invest in more water efficient farm infrastructure.

Bill Ferguson views the improvements on his property as an integral component of a larger modernisation project across the Trangie district that will have long lasting benefits for agriculture and for the local community that the irrigation sector supports.

"The benefits of this modernisation will flow on to the next generation of farmers, making the irrigation sector more productive and sustainable," said Bill

Along with the bankless channel system, a new reservoir cell was installed on Warawee to create a more efficient water storage.

The smaller surface area of the deeper cell means less water is lost to evaporation. The improved design of the reservoir cell in conjunction with the bankless layout has enabled higher flow rates in channels, faster watering, more efficient water transfers to fields and better timing of irrigation.

An on farm water storage split into cells to reduce evaporation.

Storage reconfiguration and deepening can dramatically reduce water losses to evaporation and seepage.

On Farm Water Storage

On farm water storages are the largest source of water loss for most irrigation businesses. Storage reconfiguration and deepening can dramatically reduce losses to evaporation and seepage, making upgrades to storage infrastructure a prime target for STBIFM funding.

The larger the surface area exposed to the sun, the larger the evaporative losses. Changing the shape of a farm dam and making it deeper, can reduce the surface area compared to the total volume of a storage.

Installing clay lining to stop seepage, or consolidating small, shallow dams into a single deeper storage can also reduce water losses.

Peter Maxwell at the site of the storage upgrade on his property Top River.

Peter Maxwell from Gunnedah received STBIFM funding to split his existing storage into cells. The project made his farm storage more efficient and improved the reliability of his water supply.

"The summer rain just doesn't seem to be there anymore. When it does come, it comes in a rush in five or six inches then you've got nothing for a month or two," said Peter.

"Being able to store it and have it there on hand saves you at the end of a crop and really reduces the risk of farming."

According to Peter STBIFM support has been crucial in improving the efficiency and capacity of his on farm storage.

"We've had all these works earmarked to do for 10 to 15 years but [without STBIFM] we just couldn't afford it".

Jim Wall on his property Athelstone at Wee Waa in the Namoi catchment.

In the program's first funding round in 2012, STBIFM helped **Jim Wall** to construct an updated 730 megalitre above ground water storage on his property Athelstone at Wee Waa.

The project also included the installation of an upgraded pump station, earthworks and pipes.

The new storage allowed the Walls to utilise a high flow licence and to capture tail water returns and approved overland flow entitlement.

Infrastructure modernisation on Athelstone is estimated to have recovered water losses totalling 263 megalitres, with 73% of that amount permanently transferred to the Commonwealth Environmental Water Holder.

According to Jim, the STBIFM program was not about giving up water, but about increasing profitability through efficiency.

"We have made significant water savings with the infrastructure change but the real value for us is the improvement in our water security," said Jim.

Automated Pipes through the Bank

Pipes through the bank systems combined with automated technology can offer irrigators greater water efficiency and time savings, particularly on country that is too flat to incorporate bankless irrigation.

In traditional furrow irrigation, siphons are manually placed in each irrigation furrow every time a field is watered. With the pipes through the bank system, the pipes are installed permanently in the earth bank at the top of the field, to automatically deliver water to the field when the adjacent channel is filled.

Thanks to funding from STBIFM, pipes through the bank infrastructure has become a core component of **Steve Carolan's** irrigation system.

In 2015 Steve converted 108 hectares to the new system on his property, Waverley, at Wee Waa. It worked so well he applied for further funding through STBIFM and by June 2018 he had extended pipes through the bank irrigation to an additional 2100 hectares.

New pumps and channel infrastructure were also installed with STBIFM assistance, increasing the capacity to get water on and off fields more quickly, reducing evaporation and seepage and dramatically improving water use efficiency.

The fully automated set up consists of 75 mm pipes at 2 metre spacings. Water is supplied to the pipes through a series of telemetry operated gates and channels that can be opened and closed from a mobile phone.

Technology allows remote control of water flows to fields.

Turn Key Ready Cropping

Automated pipes through the bank irrigation and new STBIFM funded infrastructure has increased Steve Carolan's production capacity. In any given season he can now plant more of his irrigation area than was previously possible, without extra staff.

Steve says the new infrastructure has made his cropping system more flexible with every paddock now 'turn key ready' to irrigate at any time.

"We could decide in winter to irrigate grain crops, and we're already set up, we don't have to go and shift pipes and make changes."

Steve Carolan (centre) with farm manager Andrew Greste (left) and STBIFM project officer Peter Verwey.

Benefits of Automation

An automated irrigation system has delivered labour savings, an increased flow rate, better water use efficiency and improved yields for Steve Carolan.

"While we have had labour savings, our increased production capacity means we have more work for our permanent on farm labour force. We haven't had to put any labour off," said Steve.

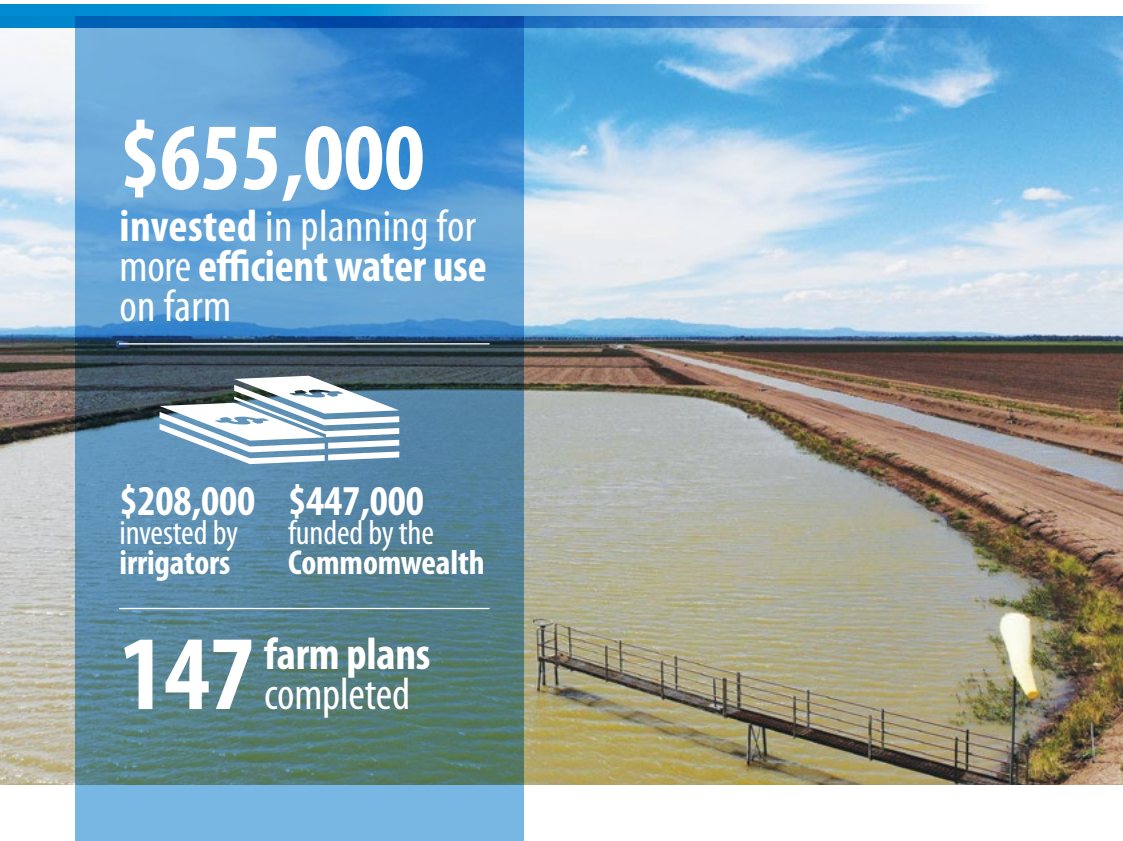
"Work time can be managed more usefully and at more convenient times of the day. We're not calling people in to work overnight or manually shifting siphons in the hottest part of the day."

"We are no longer using low skilled back packers, but our permanent workers are getting more training and are working at a higher skill level with the automation."

Farm Planning

Planning has been a key part of the STBIFM program through the Irrigated Farm Water Use Efficiency Assessment (IFWUEA) process. Preparing an IFWUEA helped project partners identify and quantify their water losses so they could formulate water saving solutions.

Carrying out a detailed assessment of on farm water losses and inefficiencies, with assistance from a certified professional, empowered irrigators to make more informed decisions about the real costs and benefits of upgrading their irrigation infrastructure.



$655,000
invested in planning for more **efficient water use** on farm

$208,000 invested by **irrigators**

$447,000 funded by the **Commomwealth**

147 **farm plans** completed

STBIFM paid a subsidy for each professional IFWUEA assessment undertaken, with irrigators contributing at least 20% of the total cost.

Boomi Irrigator, **Georgia Brown**, completed an IFWUEA in 2017, that revealed the water losses on her property were much larger than she had anticipated.

Obtaining accurate data on where water is being lost on farm is a critical step towards making an irrigation business more productive. Using this information to modernise infrastructure and increase water use efficiency will result in more valuable water being applied to the crop and less lost to evaporation and seepage.

"It was definitely an eye opener. We knew we had issues with our field and channel layout, but when we did the calculations it was a surprise to see just how great the water losses were," said Georgia.

Georgia and her husband Andrew say the process has helped improve seasonal water budgeting and they have now implemented water use efficiency assessment procedures into their long term planning.

"The assessment has given us the knowledge to make better calculations when comparing the costs of investment against the gains we can make through recovering water."

Goondiwindi based consultant **Peter Leeson** assisted many STBIFM project partners with water use efficiency assessments.

"It can be a difficult process and the paperwork can be quite off-putting for a lot of people. However, in my experience, it's definitely worthwhile," said Peter.

"Almost every irrigator has some idea about where they might be losing water, but it's illuminating when you see the actual figures."

"Working through the process makes people look at their situation more clearly and turns suspicions into hard data."

"When you have evidence based calculations in front of you, you're no longer just guessing. When you have that concrete information you can make better decisions about where you head next to get the best bang for your buck."

"If you are seriously thinking about making changes to your farming operation or upgrading infrastructure, then a water use efficiency assessment is a useful tool."

Crockweld steel fabrication employees Connor Stanfield (left) and Jason Manning, with business owner David Johnson (centre).

Social Benefits

Small town contractors and local workers have shared in the benefits of the STBIFM program with the majority of irrigator partners using local businesses to install new infrastructure.

David 'Crocket' Johnson runs Crockweld, a steel fabrication and welding business. He and his three employees make water gates, pipes and distribution tanks for irrigators.

According to David, STBIFM supported projects have given a significant boost to the local economy.

"STBIFM grants have certainly spurred on the amount of work available for small players like us."

"Almost all of our jobs relate to agriculture, including servicing and truck repairs for other businesses that work for the farmers. The whole town, every business in Wee Waa, relies on the irrigation sector."

"When we benefit from these sorts of projects, we try to spend our money locally as well. I use local suppliers where ever I can to contribute to the local economy."

"The irrigation sector is the main industry in town and when the farmers are doing well the whole community prospers" – Matt Shearin.

Self-employed excavator and harvesting contractor **Matt Shearin** has also seen the flow-on effect from infrastructure modernisation projects.

"The fuel companies, the steel suppliers, the blokes driving trucks to bring in equipment, the contractors who supply the laser buckets, they all benefit," said Matt.

Based in Wee Waa, his three children attend local schools, and he leases land for his own small farming operation.

Matt has supplied harvesting services for the cotton industry for many years and has just expanded into a new business with the purchase of a thirty tonne excavator.

His first excavator job was with the Schwager family's STBIFM project at Fernleigh, completing channel work, removing outdated infrastructure, and installing new pipes and gates.

"These infrastructure upgrades are setting the farmers up to make them more productive and more viable in the long term, which means there will be ongoing work for businesses like mine."

Wee Waa farmer **Richard Schwager** is confident that STBIFM supported farm modernisation and greater water use efficiency in the irrigation sector will help sustain rural communities.

"We'll be able to maintain our production with less water and that means we can survive longer during dry periods, helping to flatten out, at least to some degree, the usual boom and bust cycle in agriculture," said Richard.

"A viable farm sector also means we can retain our schools, our hospitals, and aged care services so we can keep our family and friends close to where they have lived and worked throughout their lives."

"Strong farms make strong country towns and vice versa. It's really important to maintain these communities, not just from an economic perspective, but because of the social benefits as well," said Richard.

Liam and Richard Schwager believe STBIFM funding has made a big difference to the long-term sustainability of the family business.

Better Working Conditions and Improved Health & Safety

For smaller farmers like **Richard and Carmel Schwager** and their son Liam, the labour savings gained through farm modernisation are making a big difference to their work-life balance.

"Because we are a smaller operation we don't usually have the capacity to put on extra staff, we just put in very long hours during that busy part of the season. That's difficult to sustain and it raises safety issues," said Richard.

Now that the Schwagers have converted from siphons to a bankless channel irrigation system, the work load has been dramatically reduced and there is far less night work.

"Instead of changing 160 siphons every eight hours, we turn the wheel on the gate or open a weir and the job is done," explained Richard.

"Anything that means they are not going down the paddock in the middle of the night is definitely an advantage," said Carmel Schwager. "And if we no longer have those days when everyone at home is compelled to work excessive hours out in the heat in the paddock, that's a big bonus."

Thank you to all of our project partners who have worked with the STBIFM team from 2012 to 2019, particularly to those who have so generously contributed their knowledge and expertise to the case studies featured in this publication.

The STBIFM program has been funded through the Australian Government's Sustainable Rural Water Use and Infrastructure Program (SRWUIP) and has been delivered through the NSW Department of Primary Industries. The SRWUIP is a key mechanism of the Australian Government $13 billion Murray–Darling Basin (MDB) Plan.