BSES Limited

FINAL REPORT - SRDC PROJECT BSS269

A NEW CROPPING SYSTEM FOR THE CENTRAL DISTRICT

by

BRADLEY HUSSEY

SD09001

Contact:
Brad Hussey
Extension Officer
BSES Limited
PMB 57
Mackay Q 4740
Telephone: 07 49636810
Facsimile: 07 49545167
Email: bhussey@bses.org.au

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SUMMARY

This project has worked with growers in Central cane-growing districts to assist them (and others throughout the industry) to adopt the principles of the New Farming System that were identified by the Sugarcane Yield Decline Joint Venture.

During the project, 43 group activities were conducted. These activities took the form of shed meetings, bus tours, field days and information days. Activities were held in all districts of the Central cane-growing region - the Proserpine, Mackay and Sarina districts.

A system change-over kit was produced to help cane growers and extension staff with the adoption of the new farming system. The kit was designed as a 'how to kit' and comprises fact sheet on various aspects of the farming system.

In the final year of the project, a state-wide extension program was conducted. During this activity, the new farming system team met with all of the extension officers and agronomists from BSES, as well as many staff from agencies such as QDPI&F FutureCane and the productivity service companies. Many of the staff were exposed to the work on the new farming system twice - once during a visit to their region, and once at a larger meeting such as the QCrops' meeting or the extension officers' meeting.

On-farm trials were an important part of the project, with 14 row-spacing trials established. These trials were conducted in all Central mill districts and 34 harvests were completed. Three row-spacings, 1.5 m single, 1.8 m single and 1.8 m dual rows, were trialled. These trials showed that row spacing has little or no effect on yield.

The project team had six items of farm machinery available to them during the project - a dual-row double-disc-opener cane planter, soybean planter, bedformer, ripper, elevator extensions, and a transport trailer. This allowed them to assist growers to establish an area of the new farming system on their farm with little or no capital outlay. This machinery has also been used extensively during field trials and has assisted growers in making decisions on the equipment they need for the new farming system.

Almost 2000 ha were planted to the new farming system in the Mackay region in 2007, with additional areas planted in the Sarina and Proserpine regions. In total, the Mackay region now has over 5000 ha of cane grown on controlled-traffic systems with row spacings of 1.8 m or more.

During the life of the project, 13 grower surveys were completed. These surveys gave the project team a clear understanding of the practices being undertaken by the growers in the project. Of interest is that 75% of growers felt that the system is working well on their farms and all growers are still making changes to the system. These changes will lead to improvements to the system and a higher level of satisfaction with the system.

Growers saw the biggest benefits of the project as the ability to mix with other growers who are trialling the new system, as well as the use of the project equipment to trial the system.

1.0 BACKGROUND

Significant research had been conducted by the Sugar Yield Decline Joint Venture as to the factors that result in yield decline. These researchers identified changes that could be made to the current farming system. These include:

- Adoption of a controlled-traffic farming system to manage soil compaction
- Inclusion of a fallow legume crop to break disease cycles and add nitrogen to the system
- Reduced tillage to preserve soil structure.

Although this research had been largely completed and the results extended to growers, there was very little adoption of the new farming systems (NFS) by Central district growers in 2003. Several impediments to the adoption of the system were identified, including:

- The need to change equipment to enable the adoption of the new system
- The need for some local demonstration trials, as much of the work had been completed in other districts.

It was with these needs in mind that this project was established in 2004.

2.0 OBJECTIVES

The project aimed to:

1. Facilitate establishment of new cropping system trials with both existing and new productivity groups, by providing equipment and technical guidance
2. Develop best-practice guidelines for dual-row cropping systems (weed control, irrigation, canegrub control, variety selection and nutrition)
3. Develop 'cost of production comparison models' and a 'system change-over kit' to facilitate decision making and system change
4. Monitor and evaluate the environmental performance of the system in terms of run-off water quality
5. Target 1000 ha planted under the new cropping system by 2008 (in the Central district)
6. Conduct state-wide extension in year 4.

These objectives were met during the life of the project. The following gives a brief summary of the activities undertaken to meet these objectives

Facilitate establishment of new cropping system trials with both existing and new productivity groups, by providing equipment and technical guidance

Trials were conducted on the farms of many of the growers in the NFS Group. Many of these trials took the form of row-spacing trials, where a wider controlled-traffic row spacing was compared to the grower's existing row spacing. The availability of the farming-system equipment and technical assistance of the project team made these trials possible.

Develop best practice guidelines for dual-row cropping systems (weed control, irrigation, grub control, variety selection and nutrition)

Develop 'cost of production comparison models' and a 'system change-over kit' to facilitate decision making and system change

A system change-over kit was produced to help cane growers and extension staff with the adoption of the new farming system. The kit was designed as a 'how to kit' and comprises fact sheet on various aspects of the farming system. It was distributed to all growers through the *BSES Bulletin*.

Monitor and evaluate the environmental performance of the system in terms of run-off water quality

Water quality monitoring was undertaken through the establishment and monitoring of six trials. Plant and ratoon crops on both the old 1.5 m farming system and the new 1.8 m farming system were monitored.

Target 1000 ha planted under the new cropping system by 2008 (in the Central district)

The objective of 1000 ha planted to the new cropping system was exceeded, with almost 2000 ha planted in the Mackay region in 2007 alone, with additional areas planted in the Sarina and Proserpine regions. In total, the Mackay region now has over 5000 ha of cane grown on controlled-traffic systems with row spacings of 1.8 m or more.

Conduct state-wide extension in year 4

A state-wide extension program was conducted in the final year of the project. This program comprised two road trips, one to the north and one to the south, and three information meetings. At the completion of the state-wide extension program the NFS team had met with all of the extension officers and agronomists from BSES, as well as many staff from agencies such as QDPI&F FutureCane and the productivity service companies. Many of the staff were exposed to the work of the NFS team twice - once during a visit to their region and once at a larger meeting such as the QCrops' meeting or the extension officers' meeting.

3.0 EXTENSION PROGRAM

The extension program for the project had two broad aims:

- Support the growers who were trialling the NFS on their farms
- Share the results and messages with the wider growing community both locally and state-wide.

Growers in the project

During the project, the staff worked with a core group of about 40 growers who were trialling the NFS on their farms. These growers were supported with:

- One-on-one farm visits, where the project staff visited the growers on their farms to discuss the issues of the farming system with the grower directly

- Focus groups, where a group of like-minded growers met together to discuss the NFS and the changes or obstacles that they were facing
- Workshops, where information was presented to the group by experts on the topic
- Participatory on-farm learning experiences that took the form of bus tours, farm walks and shed meeting and that were held with the group to share ideas and demonstrate new practices.

All growers in the Central district

By operating an extension program with a two-pronged approach, we were able to keep the wider growing community up-to-date with the progress being made with the NFS. The extension methods used with the larger growing community were different to those of the smaller group and included:

- Field days –field days were conducted where the general growing community was invited to come and see the work of the NFS project
- Bus trips – bus trips where the work of growers using the system was put on display to the general public
- Shed meetings –BSES conducted at least one round of general shed meetings each year and at these meetings the findings of the NFS project were presented
- Media – during the project, articles were prepared for the media, with information and stories in the local rural papers, ABC radio, Canegrower magazine and the *BSES Bulletin*
- A state-wide extension program was conducted in year 4 of the project.

3.1 Group extension activities carried out during the life of the project

Activity 1 – July 2004 – Farm walk

Farm walk at the SYDJV site to inspect logging and mature cane stands (10 growers).

Activity 2 – July 2004 – Farm walk

Farm walk at Graham Davies' farm to inspect single-row cropping in controlled traffic (1.8 m) (20 growers).

Activity 3 – August 2004 – Training course

Chickpea agronomy training course (3 project staff) - to determine chickpea's suitability in the sugarcane system.

Activity 4 – August 2004 – Planning meeting

A planning meeting with the focus group was held to identify growers wishing to participate in first-year trials. At this meeting, the knowledge gaps of growers were also identified and a plan to address the gaps was formulated.

Activity 5 – February 2005 - New Farming Systems cane-planting bus trip

40 growers attended the trip and viewed various cane-planting equipment used by growers who were adopting aspects of the NFS.

Figure 1 Planting technology bus tour

Activity 6 – February 2005 - Grub management meetings
Grub management/control meeting were held with the Sarina Sustainable Farmers' Group; 20 growers attend these meetings. Grub control in crops planted with disc-opener planters was a concern for growers. Data from the plant-cane harvest of a grub-control trial planted with a disc-opener planter was presented to the group. Three members of the group were cooperating with Dr Peter Samson by providing trial sites.

Activity 7 – March 2005 - Field walk
Eight growers attended a field walk through the soybean-sprayout trial. Successful sprayout control of soybeans was problematic over the previous seasons and growers were achieving variable results. This demonstration trial included three herbicide combinations by two water rates.

Activity 8 – March 2005 - Shed meetings
13 shed meetings were held with 120 growers attending. Discussions at the shed meeting covered controlled-traffic farming systems issues, results of dual-row variety trial harvests, and results of grower-established controlled traffic versus conventional demonstration trials. Two of the grower trials showed improved yields under a dual-row planting configuration, whilst the third site showed a significant reduction in yield and CCS in the dual-row field. The latter result is due to water run-off from the beds on the surface sealing soil on which the trial was located**.**

Activity 9 – March 2005 - Soybean farm walk
A soybean farm walk was held in Proserpine. QDPI&F staff assisted with the farm walk, which focused on growing soybeans for grain production. 20 Proserpine growers attended the event.

Activity 10 – April 2005 - NFS Bus trip

SSP (Sugar Services Proserpine) conducted a bus trip and 40 growers attended the trip and were shown a range of local innovations, including soybean herbicide trial results, double-disc soybean planter from Mackay, and dual-row double-disc opener cane planter from Mackay. The SSP controlled-traffic trials in cane at Ian Cowan's and Bill Atkinson's were also visited. Alan Cooke, the harvester driver for a large harvesting group in Proserpine, spoke to the group about the 'Cookie-Cutter', a modification to the cane harvester to allow it to harvest dual-row plant crops.

Activity 11 – May 2005 - Combined BSES and MAPS NFS Bus tour

This whole-day bus tour was held in May at the request of the growers who attended the March-April round of shed meetings to learn more about the NFS. 140 growers on three coaches travelled to farms in the Mackay region. The NFS was showcased using farms from the Back on Track group, as well as the Sarina New Farming System group.

Activity 12 – May 2005 - Display at the BSES field day

The NFS project presented a highly interactive display for cane growers at the BSES Mackay field day. 1500 people attended the field day, which featured very well attended NFS demonstrations and static displays. The NFS project equipment, comprising a bed former, soybean planter, transport trailer, Fiat tractor adjusted to 1.8 m, and Berends ripper, were on display and also actively demonstrated. The NFS project also brought in growers' equipment, which featured advanced guidance technology, for display to growers in the form of a GPS-guided cane harvester and tractor and modified dual-row disc-opener billet planter. In the NFS tent there were handouts of the newly produced 'Growing soybeans in a cane rotation – Central District', which was produced by funds from the NFS project, and video footage of block operations featuring fallow crop option operations that took place on BSES Mackay over the previous 9 months. Growers were also treated to a demonstration of sowing chickpeas over the 2 days of the field day

Activity 13 – August 2005 - NFS Grower group reflections meeting

A NFS group meeting was held on 15 August 2005. 22 growers attended and shared their experiences with the NFS.

Activity 14 – October 2005 - Growing fallow peanuts – Proserpine

The aim of this meeting was to outline the agronomy and economics of growing peanuts, to cane growers in the Proserpine area. Peanuts are seen as a good rotational crop to be grown with cane and can product quite good returns as a fallow crop. Eight growers attended this meeting.

Activity 15 – October 2005 - Growing soybeans for seed - Mackay

The aim of this workshop was to help those growers who had already grown soybeans as a fallow crop to go to the next level and produce a crop suitable for harvesting for seed. This workshop was a joint effort between the BSES NFS team and the QDPI&F FutureCane team. 20 growers and 10 industry representatives attended this workshop.

Activity 16 - November 2005 - NFS harvesting bus tour

This bus tour was open to all growers and was held during the crushing to demonstrate harvesting of dual rows on a controlled-traffic system. The half day bus tour visited four harvesters who were cutting dual-row cane on the day. The four harvesters visited were Allan Farquahar, Gerry Deguara, Chris Blackburn and Bruce Davies. All four of these growers are part of the NFS group. 26 growers attended this event.

Figure 2 Growers examining Bruce Davies's harvester during the bus tour. Note the elevator extension used to harvest 1.8 m rows

Activity 17 – December 2005 - Sarina Sustainable Farmers Group planning meeting

The R&D plan of the Sarina Sustainable Farmers Group was reviewed and trials planned. Previous group activities, including the harvester-elevator-project progress and plans, were also reviewed. 12 growers attend this activity

Activity 18 – December 2005 - NFS focus group meeting - Mackay

This invitation-only meeting involved 22 growers and was held at night at BSES Mackay. The purpose of this meeting was to identify the changes growers had made to their farming practices and outline the trials that had been established. The opportunity was also taken to identify any further needs or areas where the project could assist with trials or equipment.

Activity 19 – February-March 2006 - One round of general shed meetings

A round of 38 shed meetings was held in the Mackay district, as well as 8 in Proserpine and 10 in Sarina. These meetings ran for 2-4 hours and covered a range of topics in small grower groups of 10-20 growers. In all, 600 growers attended this round of meetings. The topics and the discussion were led by the growers. The components of the NFS were discussed at length in these small groups and in some cases growers in the group were given the opportunity to visit the farm of a fellow grower who had adopted the system on his own farm. These tours, held after the meetings, typically visited one farm and ran for about 1 hour. Examples of group tours after the shed meetings were:

- Group 1 visited variety trial on 1.8 m spacing

- Group 2 visited Russ Gibson's farm and looked at soybean fallows and 1.8 m cane
- Group 3 visited Paul Argent's farm and looked at 1.8 m dual rows and legume fallows
- Group 4 visited Paul Mackay's farm and looked at bed-forming and bean planting.

Activity 20 - March 2006 - NFS field day

This field day was held at BSES Mackay in conjunction with QDPI&F FutureCane. The aim of this meeting was to present the findings to the 'unconverted' and, as such, an invitation to attend was extended to all growers. The day comprised five demonstration sites each manned by a BSES or QDPI&F staff member, as well as a grower. The 100 growers who attended the field day were split into five groups each of 20 and rotated around the five sites with 40 minutes spent at each site.

The five sites were:

1. Minimum tillage planting
2. Controlled traffic harvesting
3. Breaking the monoculture
4. Economics of the system
5. GPS guidance of tractors and implements.

After the field day very positive feedback was received from the growers.

Figure 3 Small group at the NFS field day looking at pre-formed beds

Figure 4 **Rob Sluggett at the field day explaining the compaction caused at different row spacings**

Figure 5 **Harvesting equipment display at the field day - right 1.8 m, left 1.5 m**

Figure 6 **Growers at GPS-guided bedformer display at the field day**

Activity 21 – March 2006 - Farming Systems bus tour to North Coast and Septimus grower groups

The aim of this bus tour was to follow on from the field day. If growers liked what they saw in a technical manner, they could follow up with a bus trip to growers who were implementing the system on their own farm. The bus tour was a joint effort between the North Coast and Septimus Grower Groups, the BSES NFS project and Mackay Rural Supplies. This trip was a whole-day tour that visited three row-spacing trails and a legume variety trial, as well as looking at machinery modifications. The group also discussed the selection and use of GPS guidance systems. 67 growers attended.

An evaluation sheet was completed by each of the growers at the end of the day. This evaluation highlighted two common comments:

1. Good to see machinery similar to what they had at home modified to suit the new system
2. It would be good to return to the same trial sites next year after they have been harvested and yield data was available.

Activity 22 – March 2006 - Farming Systems bus tour to Sarina

The second bus trip following on from the field day visited the Sarina Sustainable Farming Group. During this tour, growers were shown various field trials and machinery modifications made to equipment by growers who had implemented the new system. The bus tour was a joint effort between the Sarina Sustainable Farmer Grower Group, the BSES NFS project and Landmark. 50 growers attended.

Trials visited included:

- Variety trial on 1.8 m system
- Zero-till planting site
- Comparison trial mound planting verses flat planting
- Elevator extension options
- Site specific management
  - Soil mapping
  - Yield mapping
  - Soil profile identification.

An evaluation sheet was completed by each of the growers at the end of the day. This evaluation highlighted two common comments:

1. Good to see variety trial on 1.8 m system, as this data is lacking
2. It would be good to return to the same trial sites next year after they have been harvested and yield data was available.

Activity 23 –April 2006 - NFS – time for a tune up

This meeting was a joint activity between BSES and QDPI&F FutureCane. Attendance at this meeting was by invitation only, with only those growers who are actively implementing parts of the NFS invited. This was done so that the discussion could be pitched at a higher level. Aims of the meeting were to discus the various parts of the NFS and identify any gaps in current knowledge.

The agenda for the day was:

- John Hughes (FutureCane) – introductions
- Alan Garside (BSES/SYDJV) – New trial results
- Brian Robotham (Gps-Ag) – Compaction
- Sam Deguara (Farmer) – Sam's system
- Rob Lorimer (Position one consulting) – basics of GPS
- Bruce Davies (Farmer) – Bruce's system
- Brian Stevens (Farmer) – Brian's system
- Barry Salter (BSES) – Planned trials and tillering of cane
- Chris Adams (Rabobank) – Close.

The 40 growers who attended the day found it to be very worthwhile. The use of industry extension staff and grower advocates again proved to be a good mix

Activity 24 – May 2006 - BSES annual field day

The NFS project team had a considerable display at the BSES field day. The display included all of the equipment needed in the new system, as well as demonstrations of bed-forming and GPS guidance on tractors. An estimated 800 growers attended the field day and most of these would have attended the NFS display.

Activity 25 - June 2006 - NFS group reflection meeting

This meeting was held at the Walkerston Leagues Club. Growers who have been trialling the system on their farms were invited to attend the meeting to discuss the trials established in the region and to investigate the need for further trials. 40 growers were invited to attend this meeting and 22 attended.

Activity 26 - November 2006 - Planting back into beds focus group meeting

This focus group meeting discussed planting cane back into beds. This was a small meeting involving 10 of the more advanced growers who are about to start their second crop cycle using the NFS. It was from this meeting that a successful SRDC project application was developed.

Activity 27 – December 2006 - Planting bus tour and conference

This tour involved two buses with a total of 70growers. The bus trip had four stops:

1. The Yield Decline trial site
2. Tony Bugeja's planting rate trial
3. Rob Caben's dual versus single row trial
4. Water quality measurements by DNRW at Gerry Deguara's farm.

Further presentations were given at the Tommy Webster Hall after the bus tour - Peter Samson about canegrub control in the NFS, Barry Salter on stool counts and stalk populations, and Alan Garside who tied it all together. This was followed by a BBQ and further discussion by the growers with BSES staff.

Activity 28 – February 2007 - Bus tour of Burdekin growers

A group of 19 Kalamia Young Farmers visited five Central district farms on a SRDC-funded bus trip to Mackay and Sarina. The Burdekin growers visited the farms of Tony Bugeja, John Pastega, Gerry Deguara, Bruce Davies and Mike and Shane Smith.

Activity 29 – February-March 2007 - One round of general shed meetings

A round of 38 shed meetings was held in the Mackay district, as well as 8 in Proserpine and 10 in Sarina. These meetings ran for 2-4 hours and covered a range of topics in small grower groups of 10-20 growers. In all, 500 growers attended this round of meetings. The topics and the discussion were led by the growers. The results from the comparison trial cut by the growers in the NFS group were discussed.

Activity 30 – March 2007 - MAPS field day

The NFS team establish and manned a small display at the MAPS field day. 350 growers attended the day and a number of these growers had discussions with the staff at the NFS display. The opportunity was also taken to hand out flyers to advertise the NFS field day.

Figure 7 Discussion with growers at the NFS display at the MAPS field day

Activity 31 – April 2007 - Farm optimisation field day

This field day took the form of a round-robin discussion with five sessions each running for 40 minutes. The five topics discussed were:

1. Irrigation management
2. Nutrition management
3. Farm mapping and data collection
4. GPS steering systems for tractors
5. Flow controllers for the management of planters and fertiliser boxes etc.

The information session were followed by a BBQ where growers could further discuss the information presented on the day.

The attendance at this meeting was lower then expected, with only 40 growers attending. However, many of the presenters commented that the grower group was different to the usual group. This may show that were then moving on to the second round of growers who are looking to adopt the system and that the needs of the early adopter have been met with other activities.

Figure 8 Growers involved in discussion about GPS steering on tractors

Activity 32 – April 2007 - Mackay information bus trip

The information bus trip was a full-day activity and attracted 54 growers. It had five stops and was focused on alternative/alternate crops and the NFS. The five stops on the trip were:

1. Tony Bugeja, Homebush – soybean variety trial, nutrition trial, planting rate trial
2. Lawrence Bugeja, Marian – wetlands and revegetation work, kenaf trial crop harvest
3. Lunch provided with presentations on wide row trial results, Fibre Producers legume trial results (sunn hemp, soybean, guar), dual row versus wide-chute trials
4. Gerry Deguara, North Eton – soybean harvest, gross margin results
5. Lee Blackburn, North Eton – peanut harvest, gross margin results.

Figure 9 Bus trip group at Tony Bugeja's soybean variety trial site

Activity 33 – May 2007 - BSES field day

The NFS team, in conjunction with QDPI&F FutureCane group, established and manned a site at the field day. This site had information boards, as well as machinery demonstrations. To demonstrate the benefits of controlled traffic, four 1.5 m beds and four 1.8 m beds were established in the field next to the NFS tent. These beds were then trafficked with a cane harvester so that the area of compaction was very evident. This display worked very well and led to a discussion with many growers about the management of compaction and the entire farming system. These field days were well attended, with 1300 growers attending. Many of these growers moved through the NFS tent.

Activity 34 –June 2007 - Focus group meeting

A focus group meeting was held at BSES Mackay BSES at which the results from the trials harvested during the previous season were presented, as well as an update on the Sugar Yield Decline Project and managing canegrubs in the NFS. Information was then sought from the growers as to their experience with the system and future directions needed.

Activity 35 - July 2007 - Meeting with Sarina Sustainable Farmers

The project team held a meeting with the growers from the Sarina Sustainable Farmers Group. At this meeting, the group discussed the farming system and work which was needed as the group moves from the first crop cycle into the second crop cycle. The growers saw this as the next challenge as they move forward with the farming system. To aid the growers with this change, several members of the group aimed to work with the project team on the new project 'Establishing the second crop cycle into permanent beds'.

The new harvester elevator extension modification by Doug Pederson was showcased. A normal elevator extension weighs approximately 135 kg which, when hung at the very end of a harvest elevator, causes more stress on the entire elevator. A new version, weighing just 70 kg, was fabricated from aluminium, and places significantly less stress on the main elevator frame of the harvester. In addition, rather than suspending the elevator on chains as in normal practice, the extension elevator is now an integral part of the harvester elevator - this affords greater control and rigidity to the extension itself. The bin flap is considerably larger than a standard bin flap and allows the modified elevator to properly fill bins on both 1.5 m and 1.83 m row configurations.

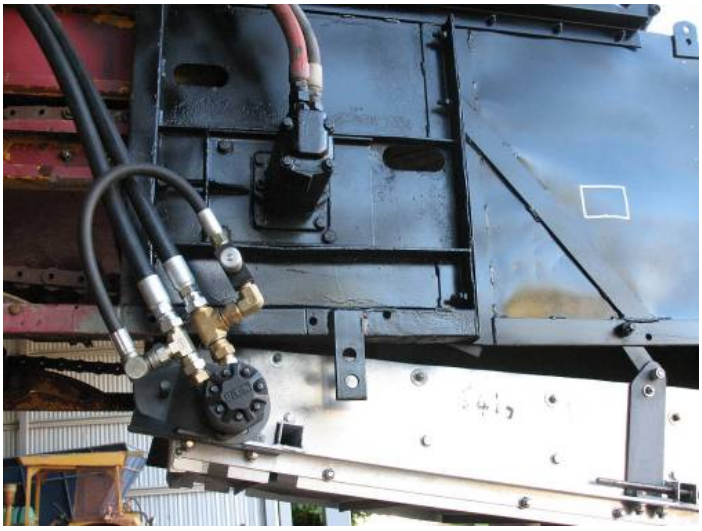

Figure 10 New aluminium elevator extension

Figure 11 New aluminium elevator extension

The issue of planting sugarcane back into existing beds for the second crop cycle was raised and addressed as a primary concern of several growers who attended. Gerry Dogao and Tim Staier of BSES outlined to PCSF the outcomes, activities and milestones that the new project 'Establishing the second crop cycle into permanent beds' seeks to achieve. The growers nominated a representative (Gerry Dogao) to be present at each focus group meeting of the new project with the aim of distributing the information back to the PCSF group.

Activity 36 - November 2007 - Machinery design meeting

A meeting was held at BSES Mackay to discuss the machinery required to implement the trials required for the project. At this meeting, we had several growers who are involved

in controlled traffic farming and several growers who are conventional 1.5 m row spacing farmers, as well as two machinery manufactures.

During the meeting, the group was shown video footage and pictures of zonal tillage equipment used in northern Queensland. A discussion was then held as to the suitability of the equipment. At this meeting it as agreed that the group should build a unit similar to the machine used by the Mulgrave Landcare group. The machine would be very adjustable, allowing us to assemble the ground-engaging parts in various layouts. To enable this, the machine would be a bolt-together not a welded unit, and, while, this would add to the over all cost of the machine, it would make it more flexible.

The two machinery manufactures at the meeting, Hodge Machinery and EHS Manufacturing, then held some discussions on the best ways to build the machine. They decided that Hodge Machinery was in the best position to build the machine.

Activity 37 - November 2007 - Calen grower meeting

A meeting was held with 16 growers at the Calen Bowls Club. The group was shown video footage and pictures of zonal tillage equipment used in northern Queensland. A discussion was then held as to the suitability of the equipment for Central district needs. The 16 growers at the meeting had only recently moved to controlled traffic and had not yet completed their first crop cycle. All felt that the move to zonal tillage was the next positive step and were in favour of the project team building a tillage unit similar to the one used by the Mulgrave Landcare group.

Activity 38 –December 2007 - Bruce Davies shed meeting

A meeting was held in the shed of Bruce Davies to discuss the project and the zonal tillage units. This small meeting was attended by Bruce, his mangers and some of the farm staff. During the meeting a DVD and photo presentation was made to the group. This meeting was held as Bruce Davies was going to build a zonal-tillage unit for his farm and we able to supply drawing of our machine and those used in the north.

Activity 39 – 19 December 2007 - Gerry Deguara shed meeting

A meeting was held in the shed of Gerry Deguara to discuss the project and the zonal tillage units. This small meeting, which was organised and led by Gerry, attracted 10 local growers, and a DVD and photo presentation was made to the group. This led to a discussion of the farming system and the move to zonal tillage. Several growers indicated their willingness to trial the new zonal tillage unit when it is constructed.

Activity 40 – February-March 2008 - BSES / MAPS shed meetings

This round of 35 meetings attracted about 45% of the growers in the Mackay industry. During these meetings one of the topics of discussion was the new project and the move to zonal tillage systems.

Activity 41 - March 2008 - Neil Blackburn meeting

A meeting was held at Neil Blackburn's farm with growers invited from the Eton and Pleystowe regions. Neil Blackburn has moved to zonal tillage and controlled traffic on a 1.83 m system. During the meeting, Neil presented to the group his NFS and his vision for the future. An economic analysis of his old system and his new system was presented to the group - this has shown a saving of $111/ha could be achieved by making the change

to the NFS. After the meeting, growers viewed the equipment used by Neil and conducted a farm tour to see blocks that have been planted using the zonal-tillage method. This meeting resulted in very strong interest from the growers who attended the day, with a number of growers interested in trialling the new zonal tillage unit on their own farm with the view to implementing a GPS-based zonal tillage system similar to Neil's.

Figure 12 Phil Ross from MAPS running through a FEAT exercise with the group

Figure 13 Growers inspecting the machinery after the meeting

Activity 42 – April 2008 - MAPS field day

Mackay Area Productivity Services held an annual field day at their plant-propagation and distribution farm at Victoria Plains. The field attracted 300 growers to see various

exhibits of varieties, herbicide and grub-control trials, as well as machinery demonstrations. During this field day, the project team displayed and demonstrated the new bed renovation machine. The machine was well received by the growers and generated considerable interest in the area of zonal tillage.

Figure 14 Field demonstration site at the MAPS field day

Figure 15 Discussion under the mango tree over lunch

Activity 43 – April 2008 - Sarina BSES/ Plane Creek Productivity Service's field day
This field day was held on the farm of Serge Beradi at Koumala, 25 km south of Sarina. The field day had several exhibiters with information on varieties, sugarcane smut, cane grub control, GPS guidance and bed renovation demonstrations. Attendance at the day was very good, with 60 growers participating.

Both the coulter ripper and bed renovator were on display and the bed renovator was demonstrated on both roughly prepared ground and sprayed-out ratoons. Growers who attended the sprayed-out ratoon demonstration were impressed at the ability of the machine and the soil tilth achieved.

Figure 16 Growers at the Sarina field day

Figure 17 Growers at the spray-out demo

Summary of group extension activities

During the life of the project, 43 group activities were conducted these activities took the form of shed meetings, bus tours, field days and information days. Activities were held in all districts of the Central cane-growing region, with activities conducted in Proserpine, Mackay and Sarina districts.

These activities attracted around 2000 growers, not including the large BSES field days and the shed meeting rounds. The latter activities attract an additional 2000 growers per year, adding an additional 6000 growers to those who were exposed to the New Farming System.

3.2 State-wide extension program

The state-wide extension program was designed to inform industry extension and agronomy personnel of the progress made by the NFS team in Mackay. The local extension staff would then deliver the message to their local growers. Discussions have been held with extension staff through the industry, with tours through northern and southern Queensland and at meetings held in Townsville, Cairns and Mackay. Several activities have been undertaken as outlined below.

In addition, the system change-over kit provides a valuable resource to industry extension staff that they could use when in discussion with local growers.

Activity 1 - Extension trip to northern Queensland
During October 2007 a study and information tour was held through northern Queensland. This trip was undertaken by Brad Hussey and Tim Staier from BSES and Phil Ross from MAPS.

During the trip, visits were made to BSES Meringa, Tully, Ingham and Burdekin. At each of the sites, discussion were held with the local BSES extension staff and field visits were conducted to meet some of the growers in the region who are implementing the NFS on their farms.

Activity 2 - BSES Limited QCrops' meeting Townsville
The QCrops' meeting was a two-day meeting held in Townsville. This meeting involved all of the BSES crop-management staff, as well some of the BSES extension staff.

During this meeting, the NFS was discussed at length. A presentation to the group was made outlining the system change-over kit that was then under development. As a result of these discussions, additional input was made to the fact sheets that make up the system change-over kit.

Activity 3 - FutureCane meeting Cairns
A three-day FutureCane meeting was held in Cairns 26-28 March 2008. This meeting involved the QDPI&F and BSES FutureCane and agronomy staff, several other BSES extension staff, local productivity company staff and several local growers.

During this meeting, the NFS was discussed at length. A presentation to the group was made outlining the progress made in the move to NFS in Mackay. The system change-over kit was also outlined to the group.

Activity 4 - Southern region extension tour
An extension tour to southern Queensland and northern New South Wales was conducted at the end of May 2008. During this tour, visits were made to Bundaberg, Childers and

Maryborough regions in Queensland, as well as visits to the mill areas in New South Wales.

At each site, discussion were held with extension staff on the progress made with NFS in Mackay and farm visits were carried out to visit growers who are implementing NFS on their farms.

Activity 5 - Extension officer meeting
A meeting of all BSES extension staff was held in September 2008. During this meeting, a presentation was made to the group on progress of the NFS team in Mackay. The system change-over kit was distributed to the group at this time.

Summary of state-wide extension program conducted
At the completion of the state-wide extension program, the NFS team had met with all of the extension officers and agronomists from BSES, as well as many staff from agencies such as DPI&F FutureCane and the productivity service companies. Many of the staff were exposed to the work of the NFS team twice - once during a visit to their region and once at a larger meeting, such as the QCrops' meeting or the extension officers meeting.

3.3 System change-over kit

A system change-over kit was produced to help cane growers and extension staff with the adoption of the NFS concepts. The kit was designed as a 'how to kit', not a 'why to kit'. This was done as there hade been numerous yield decline road shows and material that have promoted the benefits of the NFS, but little had been done in the way of how to adopt the system.

The fact sheets were designed to cover a single topic with sufficient detail to enable growers and extension staff to adopt the various components of the farming system.

A fact sheet was prepared on each of the following:

1. Growing soybeans in a cane rotation
2. Harvester modification to cut wider row spacings
3. Bedformers used in the New Farming System
4. Cane planters used in the New Farming System
5. Soybean planters used in the New Farming System
6. GPS selections tips.

Together, these six fact sheets form the change-over kit and cover the most common machinery that is now used in the NFS.

These six fact sheets were delivered to the industry through NFS articles in the *BSES Bulletin*. This ensures that the information will reach all of the growers in the industry, not just those attending NFS events.

4.0 FIELD TRIALS

During the life of the project field trial were conducted on:

- Fallow legumes
- Row spacings
- Run-off water quality
- Canegrub control.

Given that the project was an extension project working with growers groups, most of the trials were large strip trials. When strip trials were used and yield data wais to be collected from the sugar mill, each of the strips needed to be large enough to produce 30 tonnes of cane. In most cases, this means that each strip needed to be at least 0.5 ha.

4.1 Fallow legume trials

Three fallow legume trials were conducted. The emphasis of the trials was to establish a legume crop into the fallow period, and most crops were grown as a green manure crop and not for grain production.

In the early stages of the project, a number of legume planters were evaluated to identify a planter that could plant soybeans through a sugarcane trash blanket. It was from these evaluation trials that the Austill planter was selected.

Trial 1 – Russ Gibson

During the summer of 2005-06, we established a fallow-management trial. This trial had five treatments and four replicates in a replicated complete-block design. The trial was replanted to cane in September 2006 using 1.8 m single rows. The trial was harvested in 2007 to investigate the effect of the fallow treatment on the plant-cane yield. Treatments were:

1. cultivated bare fallow
2. cultivated soybean fallow
3. spray-out bare fallow
4. spray-out soybean fallow
5. ratoon cane.

This trial was harvested on 2 October 2007 using the BSES weigh truck. The four centre rows of each eight-row plot were harvested and weighed; CCS samples were collected for each plot during the harvest.

The fallow treatment had no significant effect on the yields achieved in the plant-cane crop, with all treatments producing similar yields (Table 1).

Table 1 Plant-crop yields from Gibson fallow-management trial

Parameter	Cultivate	Cultivate + soybean	Spray out	Spray out + soybean	Ratoon cane
Cane yield (t/ha)	89.4	88.4	89.0	93.4	91.7
CCS	16.81	16.43	16.83	16.86	16.40
Sugar yield (t/ha)	15.02	14.52	14.97	15.74	15.03

Trial 2 - Greg Johnson

Greg had a block where three fallow treatments were compared in one block. The first six rows in the block were planted to soybeans, the next 16 were kept as a bare fallow, and the remaining 33 rows were plough-out/replant. All rows in the block were 800 m long. The trial was planted in August 2005 with Q196$^{\phi}$. No nitrogen was applied to the strip where the soybeans were grown, but all other treatments were the same.

This trial was harvested as plant cane in 2006 with the cane from each strip consigned to a separate block number. Unfortunately, the bins from each strip became mixed and the harvest data from the plant cane was lost.

This trial was harvested again as a first-ratoon crop (Table 2). This trial demonstrates the on-going benefits of the soybean fallow.

Table 2 First-ratoon yields from Johnson fallow-management trial

Parameter	Soybean	Bare fallow	Plough-out/replant
Cane yield (t/ha)	118	91	109
PRS	13.94	14.17	14.41
Sugar yield (t/ha)	16.44	12.89	15.70

Trial 3 - Lionel Clancy

Lionel Clancy established a fallow treatment trial over the summer of 2005-2006. This trial had three treatments of fallow soybeans, fallow lab lab and bare fallow. Cane was then planted into preformed beds at a 1.8 m spacing using a single-row double-disc-opener planter.

When it came time to apply fertiliser, half of the soybean area was left unfertilised and the remaining area was treated with Liquid One Shot. This gave the trial four treatments - fallow soybeans, fallow soybean + Liquid One Shot, Lab Lab + Liquid One Shot, and bare fallow + Liquid One Shot.

Yields in all treatments of the plant crop were very similar (Table 3). This indicates that a fallow soybean crop can supply sufficient nitrogen for the following cane crop.

Table 3 Plant-crop yields from Clancy fallow-management trial

Treatment	Cane yield t/ha	CCS
Soybean	112.4	14.7
Soybean + LOS	114.8	14.3
Lab lab + LOS	112.8	14.9
Bare fallow + LOS	113.6	14.2

Fallow soybean crops cost around $100/ha to grow and will supply the nitrogen needed for the plant cane crop. To meet the nitrogen needs of the plant cane crop with conventional fertiliser would have cost $150-180/ha in 2005. Growing a fallow soybean crop can reduce the total cane-growing cost by $50-80/ha, as well as providing additional benefits in breaking the sugarcane monoculture

4.2 Row-spacing trials

During the project, we established 14 row-spacing trials and collected data from 34 harvests. Row spacing was the single biggest issue for most growers to come to terms with. Most growers could see the logic behind moving to a wider row spacing that was more suitable to the harvesting equipment, but were concerned that increasing row width would lead to lower yields.

To test these concerns, we established trials to assess the yield of the grower's standard row spacing of 1.5 m against a row spacing of 1.8 or 1.9 m. At the wider row spacing both single rows, wide single rows and dual rows were trialled:

- Single rows at 1.5 m spacing – the grower used a standard billet or whole-stalk planter to plant the cane. These have a planter chute width of 200-250 mm
- Wide single rows at 1.8 m spacing – the planter chute of the billet planter has been increased to 450 mm, this practice was undertaken as growers felt that the wider chute width would compensate for the increased row width
- Dual row at 1.8 m spacing – dual rows were planted with both double-disc-opener planters and dual-row chute planters. In these trials, the rows were planted 500 mm apart into both flat ground and into beds.

Trials 11-14 were completed by members of SRDC-funded grower groups.

Trial 1 – Jim Siver

Jim established a trial in the non-irrigated region of Farleigh mill area in 2006. During the project this trial was harvested as plant cane and first ratoon. The trial had three treatments:

- 1.5 m single conventional rows
- 1.8 m single conventional rows
- 1.8 m dual rows planted into preformed beds.

The dual rows in this trial were planted into preformed beds using the NFS's dual-row double-disc-opener planter and the single 1.5 and 1.8 m rows were planted with Jim's conventional whole-stick planter. The elevator extension was used to harvest the 1.8 m rows.

The dual rows performed better in the plant crop than did the wider single rows, but not as good in the first ratoon (Table 4). The yield of the 1.8 m single row was the same per meter of row as the 1.5 m single row, but this gave a lower yield per hectare. The single 1.5 m and 1.8 m rows were erect when harvested, whilst the dual rows on 1.8 m were lodged when harvested. The harvester driver commented that the 1.8 m rows were easier to harvest.

Table 4 Plant-crop and first-ratoon yields from the Siver row-spacing trial

Parameter	Dual row 1.83 m	Single row 1.83 m	Single row 1.5 m
Plant crop			
Cane yield (t/ha)	142	117	140
PRS	13.56	13.71	13.71
Sugar yield (t/ha)	19.31	16.09	19.13
First ratoon			
Cane yield (t/ha)	82.5	93.7	89.7
PRS	14.54	14.89	15.08
Sugar yield (t/ha)	11.99	13.95	13.52

Figure 18 Harvesting the trial at Jim Sivers' farm. Note the lodged cane in the foreground and the standing cane in the background. The lodged cane is the 1.83 m dual rows and the standing cane is the 1.83 m single rows. Also note the NFS harvester elevator extension used on the harvester to allow the haulout to remain on the wheel tracks.

Trial 2 – Robert Caben

Robert established a trial in 2006 comparing a 1.8 m dual-row system to 1.8 m wide-chute single rows. Robert used his planter, which had a removable and interchangeable planting chute to plant the trial. Robert's planter had the ability to plant wide single rows or dual rows by changing the planting chutes. All other treatment were maintained the same in both treatments with the same planting rate used in the single and the dual rows. This trial had two replicates and was harvested in October 2007 and September 2008. Yields in both years were impressive, with the wide single rows slightly ahead of the dual rows in both years (Table 5).

Table 5 Plant-crop and first-ratoon yields from the Caber row-spacing trial

Parameter	Dual row 1.85 m	Wide single rows 1.85 m
Plant crop		
Cane yield (t/ha)	133	139
PRS	15.85	15.77
Sugar yield (t/ha)	21.1	21.9
First ratoon		
Cane yield (t/ha)	110.5	118.7
PRS	15.48	15.29
Sugar yield (t/ha)	17.10	18.14

Trial 3 – Simon Mattson

Simon established a trial with two treatments:

- 1.8 m single rows planted into beds
- 1.8 m dual rows planted into beds.

Prior to establishing the cane crop, the entire area had a fallow crop of soybeans that was harvested for grain. The trial was harvested in October 2007 and showed higher yields in the wide single rows (Table 6).

Table 6 Plant-crop yields from the Mattson row-spacing trial

Parameter	Dual row 1.85 m	Wide single rows 1.85 m
Cane yield (t/ha)	111.2	128.7
PRS	15.83	15.49
Sugar yield (t/ha)	17.6	19.93

Trial 4 - BSES demonstration block

A small demonstration trial was established at BSES Mackay to demonstrate to growers the new farming system. This trial had four varieties and two row spacings and was harvested as plant crop, and first and second ratoons.

The yields of the first-ratoon crop were outstanding (Table 7), with the yield of the dual rows (as in the plant crop) slightly ahead of the 1.5 m single rows. The yield of the

second ratoon was lower then the first ratoon, and the dual-row yield was lower then the single-row yield. We attribute this reduction in yield to harvest damage to the dual rows during the harvest of the large first-ratoon crop.

Table 7 Plant-crop, first-ratoon and second-ratoon yields from the BSES row-spacing trial

Crop/Variety	1.8 m dual rows	1.5 m single rows
Plant crop		
Q208(b)	124	104
Q170(b)	126	116
Q209(b)	109	84
Q185(b)	113	98
Average	118	101
First ratoon		
Q208(b)	164	164
Q170(b)	169	169
Q209(b)	162	153
Q185(b)	170	153
Average	166	160
Second ratoon		
Q208(b)	138	156
Q170(b)	99	105
Q209(b)	107	113
Q185(b)	101	101
Average	111	119

Trial 5 - Lawrence Bonaventura

Lawrence established a row-spacing trial comparing standard 1.5 m rows to dual rows at 1.8 m spacing. The BSES double-disc-opener planter was used to establish the dual rows in this trial and Lawrence used his own planter to plant the single rows. The trial was planted in August 2005 and was harvested in August in 2006, 2007 and 2008.

Cane and sugar yields were higher in the 1.8 m dual rows than in the 1.5 m single rows in both the plant crop and first ratoon (Table 8); there were no differences in the second ratoon.

Table 8 Plant-crop, first-ratoon and second-ratoon yields from the Bonaventura row-spacing trial

Crop/row spacing	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
Plant crop			
1.5 m single rows	65	12.3	7.99
1.8 m dual rows	72	12.8	9.18
First ratoon			
1.5 m single rows	88	13.0	11.44
1.8 m dual rows	98	13.6	13.33
Second ratoon			
1.5 m single rows	100	15.4	15.40
1.8 m dual rows	100	15.2	15.24

Trial 6 - Bruce Davies

Bruce established a row-spacing trial in August 2003 to compare his then current system of 1.5 m row width to the wider 1.8 m rows. Two blocks of cane (each 4 ha) were established. The 1.8 m block was planted with a wide-chute billet planter and the 1.5 m rows were planted with a standard whole-stick planter. The variety Q157 was planted in the trial.

The wider row spacing of 1.8 m produced higher cane yields, averaging 111.4 t/ha as compared to 105.0 t/ha in the conventional planting (Table 9). However, the PRS was lower in the wider rows, averaging 14.82 compared to 15.33 in the 1.5 m system. The 1.8 m system averaged 17.11 t sugar/ha and the 1.5 single rows averaged 16.67 t sugar/ha.

Table 9 Plant-crop, first-ratoon, second-ratoon, third-ratoon and fourth-ratoon yields from the Davies row-spacing trial

Crop	1.8 m wide row		1.5 m conventional	
	Cane yield (t/ha)	PRS	Cane yield (t/ha)	PRS
Plant cane	133	14.16	128	14.45
First ratoon	113	15.62	103	15.96
Second ratoon	108	15.40	105	16.03
Third ratoon	108	14.12	99	14.89
Fourth ratoon8	95		90	
Average	111.4	14.82	105.0	15.33

Trial 7 - Ian Cowan

Using a DNRW grant to Canegrowers Proserpine Sugar Services, Ian Cowan established commercial scale trials in mid 2004 to improve the adoption of controlled-traffic sugarcane systems in the Proserpine district. The trial was established to compare the yields of dual rows 0.5 m apart at 1.8 m centres to conventional 1.52 m rows and 1.8 m single rows. During the second-ratoon harvest, the fuel used by the harvester was also measured.

Yield data (Table 10) shows cane yield was highest in the plant cane in the 1.52 m single row treatment and lowest in the 1.8m single row treatment in the plant cane. However, by the third ratoon the 1.8 m single row treatment had edged ahead of the other treatments. An overall comparison of the tonnes cane harvested from each treatment shows the dual row treatment led the other treatments with a total of 462.3 t. The lowest yield was the 1.52 m single row with 450.3 t.

Sugar yield data shows the 1.8m single row treatment having the highest tonnes of sugar over the four years with the 1.8m dual row the lowest. The CCS of the dual row was lower than the other two treatments every year and this is reflected in the lower total sugar yield. Over the four years, the CCS of the 1.8 m duals was on average 0.4725 lower than the 1.8 m singles and 0.5 below the 1.52 m singles.

Analysis of the accumulated net return after harvest and levies have been deducted shows that lower CCS levels have a very marked impact on dollar returns to the grower. The 1.8 m single row treatment had the highest net return, followed closely by the 1.52 m single rows, and then by the 1.8m dual row treatment. The difference over the plant and three ratoons totalled $520/ha.

The net return after harvesting and levies is the most accurate measure of the performance of each of the treatments. There was a very rapid decline in yield in the 1.52 m single row treatment with an average of 18.6 t cane/annum reduction. The treatment that declined least over the period was the 1.8 m singles. Close inspection of the trial at harvest showed the 1.52 m treatment was run over the most by harvest equipment, followed by the 1.8 m duals, then least of all in the 1.8 m treatment. Harvester tracks and haulout wheels remain at least 350 mm from stool in the 1.8 m treatment, except when reversing under the elevator.

Table 10 Plant-crop, first-ratoon, second-ratoon, and third-ratoon yields from the Cowan row-spacing trial

Crop/Row spacing	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
Plant crop			
1.5 m single rows	140.7	15.46	21.75
1.8 m single rows	136.3	15.41	21.01
1.8 m dual rows	137.9	14.69	20.26
First ratoon			
1.5 m single rows	121	15.00	18.15
1.8 m single rows	123	15.03	18.48
1.8 m dual rows	124	14.41	17.86
Second ratoon			
1.5 m single rows	104	14.41	14.98
1.8 m single rows	107.9	14.36	15.49
1.8 m dual rows	110.5	14.07	15.54
Third ratoons			
1.5 m single rows	84.9	15.69	13.32
1.8 m single rows	90.5	15.63	14.15
1.8 m dual rows	90.4	15.37	13.89

There was slightly less fuel used to harvest each tonne of cane from the 1.8 m single rows than from the other configurations (Table 11).

Table 11 Fuel used per tonne of cane harvested in the second ratoon of the Cowan row-spacing trial

Row spacing	Fuel used for harvesting (L/t)
1.5 m single rows	0.63
1.8 m single rows	0.57
1.8 m dual rows	0.61

Trial 8 - Neville Blackburn

Neville Blackburn double-fallowed a block with a crop of chickpeas followed by a crop of peanuts. The block was then divided in two and two row-spacing treatments planted - 1.5 m conventional (2.3 ha) and 1.8 m wide-chute (3.15 ha).

The crop has demonstrated slight cane yield benefits from the 1.8 m wide-chute planting in both the plant crop and the first ratoon (Table 12).

Table 12 Plant-crop and first-ratoon yields from the Blackburn row-spacing trial

Crop/ Row spacing	Cane yield (t/ha)
Plant crop	
1.5 m single rows	120
1.8 m single rows	130
First ratoon	
1.5 m single rows	128
1.8 m single rows	132

Trial 9 - Doug Lee

Using a DNRW grant to Canegrowers Proserpine Sugar Services, Doug Lee established commercial scale trials in mid 2004 to improve the adoption of controlled traffic sugarcane systems in the Proserpine District. The trial was established to compare the yields of dual rows 0.5 m apart at 1.8 m centres to conventional 1.5 m rows.

Yields of the two treatments were similar in both years (Table 13).

Table 13 Plant-crop and first-ratoon yields from the Lee row-spacing trial

Crop/ Row spacing	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
Plant crop			
1.5 m single rows	140.0	14.78	20.7
1.8 m dual rows	141.4	13.97	19.8
First ratoon			
1.5 m single rows	107.0	14.39	15.4
1.8 m dual rows	103.0	14.54	15.0

Trial 10 - Mike and Shane Smith

Mike and Shane Smith established a row spacing trial at Ilbibie in 2005. This trial was harvested as a first ratoon in 2006**.** There was no difference in cane or sugar yields (Table 14).

Table 14 First-ratoon yields from the Smith row-spacing trial

Row spacing	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
1.5 m single rows	107	14.39	15.4
1.8 m dual rows	103	14.95	15.4

Trial 11 - John Simpson -North Coast Grower Group

John established a row-spacing trial to compare conventional 1.6 m rows to 1.8 m wide rows using the variety Q157. When this trial was harvested, data was collected both through the mill system and by harvesting a small area with the weigh truck and collecting CCS samples for processing through the BSES small mill.

There was little difference between treatments in any yield parameter (Table 15).

Trial 12 - Michael Zamparutti - North Coast Grower Group

Michael established a row spacing trial to compare conventional 1.6 m rows to 1.8 m wide rows using the variety Q197$^{\phi}$. When this trial was harvested, data was collected both through the mill system and by harvesting a small area with the weigh truck and collecting CCS samples for processing through the BSES small mill.

The cane and sugar yields of the plant crop and first ratoon were lower in the wider rows (Table 16).

Table 15 Plant-crop and first-ratoon yields from the Simpson row-spacing trial

Weigh truck and small mill CCS data

Crop/ Row spacing	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
Plant crop			
1.6 m single rows	125	13.6	17
1.8 m dual rows	130	13.4	17.42
First ratoon			
1.6 m single rows	109	16.27	17.7
1.8 m dual rows	104	16.5	17.2

Mill data

Crop/ Row spacing	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
Plant crop			
1.6 m single rows	117	14.85	17.37
1.8 m dual rows	120	15.21	18.25
First ratoon			
1.6 m single rows	97.3	15.66	15.2
1.8 m dual rows	98.22	15.8	15.5

Table 16 Plant-crop and first-ratoon yields from the Zamparutti row-spacing trial

Weigh truck and small mill CCS data

Crop/ Row spacing	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
Plant crop			
1.6 m single rows	92	12.4	11.4
1.8 m dual rows	89	11.9	10.6
First ratoon			
1.6 m single rows	94	17.7	16.7
1.8 m dual rows	81	17.3	14.1

Mill data

Crop/ Row spacing	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
Plant crop			
1.6 m single rows	97	13.3	12.9
1.8 m dual rows	78	12.9	10.0
First ratoon			
1.6 m single rows	82	14.5	11.9
1.8 m dual rows	76	14.5	11.0

Trial 13 - Wayne and Gary Comelli - North Coast Grower Group

Wayne and Gary established a row spacing trial to compare conventional 1.6 m rows to 1.9 m wide rows. When this trial was harvested, data was collected both through the mill system and by harvesting a small area with the weigh truck and collecting CCS samples for processing through the BSES small mill.

There was little consistent difference between yields (Table 17).

Table 17 Plant-crop and first-ratoon yields from the Comelli row-spacing trial

Weigh truck and small mill CCS data

Crop/ Row spacing	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
Plant crop			
1.6 m single rows	110	13.7	15.1
1.9 m dual rows	113	12.7	14.4
First ratoon			
1.6 m single rows	100	17.0	17.1
1.9 m dual rows	101	17.1	17.4

Mill data

Crop/ Row spacing	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
Plant crop			
1.6 m single rows	113	13.5	15.3
1.9 m dual rows	109	13.1	14.3
First ratoon			
1.6 m single rows	93	15.3	14.3
1.9 m dual rows	98	15.3	15.0

Trial 14 - Col and Gergina Vassallo - Septimus Grower Group

Col and Gergina Vassallo from the Septimus Growers group established a row spacing trial in 2006 to compare two varieties Q205$^{(l)}$ and Q209$^{(l)}$ on both a 1.5 m row spacing and a 1.83 m dual row spacing. During the harvest of the first-ratoon cane, the yields of the 1.5 m and 1.83 m dual row system were separated but the varieties were combined.

This trial showed that the 1.5 m system out-yielded the 1.8 m system (Table 18).

Table 18 Plant-crop and first-ratoon yields from the Vassallo row-spacing trial

Crop/Row spacing	Variety	Cane yield (t/ha)	CCS	Sugar yield (t/ha)
Plant crop				
1.5 m single rows	Q209$^{(l)}$	118	16.8	19.8
	Q205$^{(l)}$	135	17.3	23.3
1.83 m dual rows	Q209$^{(l)}$	114		
	Q205$^{(l)}$	129	16.3	21.0
First ratoon				
1.5 m single rows		121	13.86	16.82
1.83 m dual rows		109	12.57	13.76

Summary

Table 19 shows the yield data of all of the row-spacing trials harvested during the life of the project:

- 14 trials established
- Row-spacing trials conducted in all mill districts

- 34 harvests completed
- 3 row spacings trialled 1.5 m single, 1.8 m single and 1.8-1.9 m dual rows
- Row spacing has little or no consistent effect on yield
- Growers can move with confidence to a row spacing that suits their harvesting equipment.

Table 19 Cane yield from the row spacings harvested as plant and ratoon cane in 2006, 2007 and 2008

Crop class	1.5 m single rows		1.8 m single rows		1.8 m dual rows	
	Cane yield (t/ha)	PRS / CCS	Cane yield (t/ha)	PRS / CCS	Cane yield (t/ha)	PRS / CCS
Plant	140	13.71	117	13.71	142	13.56
1	89.7	15.08	93.7	14.89	82.5	14.54
Plant			139	15.77	133	15.85
1			118.7	15.29	110.5	15.48
Plant			128.7	15.49	111.2	15.83
Plant	101				118	
1	160				166	
2	119				111	
Plant	65	12.3			72	12.8
1	88	13			98	13.6
2	100	15.4			100	15.24
Plant	128	14.45	133	14.16		
1	103	15.96	113	15.62		
2	105	16.03	108	15.4		
3	99	14.89	108	14.12		
4	95		90			
Plant	140.7	15.46	136.3	15.41	137.9	14.69
1	121	15	123	15.03	124	14.41
2	104	14.41	107.9	14.36	110.5	14.07
3	84.9	15.69	90.5	15.63	90.4	15.37
Plant	120		130			
1	128		132			
Plant	140	14.78			141.4	13.97
1	107	14.39			103	14.54
1	107	14.39			103	14.95
Plant	117	14.85	120	15.21		
1	97.3	15.66	98.2	15.8		
Plant	97	13.3	78	12.9		
1	81.9	14.5	76	14.5		
Plant	113	13.5	109	13.1		
1	93	15.3	98.3	15.3		
Plant	126	17			121	16.3
1	121	13.86			109	12.57
1.5 single vs 1.8 single average	108.29	14.86	111.29	14.83		
1.5 single vs 1.8 dual average	109.59	14.61			114.22	14.57
1.8 single vs 1.8 dual average			117.20	15.06	115.78	14.87

Note: The averages at the bottom of the table include only the trial data where both row spacings were present in the same trial as not all trials included all three row spacings

4.3 Run-off water quality

Six water quality trials were conducted, two in each year of the project.

In the first year, the trials were monitored and sampled manually, but this proved to be problematic as sampling needed to be carried out during the night or other inopportune times. During the next two years, the project staff used four automatic water samplers. These samplers allowed the team to operate two trial sites each year where a convention farming system and the NFS were being compared. In the second year one plant-cane and one ratoon site were monitored, and in the third year two ratoon sites were monitored.

4.3.1 Sarina site

This site was established to compare water infiltration, run-off and water quality (sediment load) for conventionally managed fallow and controlled-traffic fallow with pre-formed beds. V-notch weirs and EnviroSCAN probes were installed after planting to monitor run-off and soil/water balance. Water samples were collected manually during run-off events and analysed for sediment content.

The site was at Tinerta, 60 km south of Sarina (149.390195E, 21.876722S) on a Karloo, solodic soil. This site was chosen because of anecdotal evidence from growers using raised beds on surface-sealing soils suggesting that visually there is greater run-off from fields with raised beds than conventionally managed fields. These observations were tested and modifications to the bed system made where required.

The trial site was established with two replications of six raised beds and two replications of conventional flat fallow. Two V-notch weirs were placed in Replicate 1 of each treatment. These weirs were used to measure water run-off volume and water samples were to be taken from the weirs for sediment load analysis.

Only one rainfall event resulted in run-off from this site. 56 mm fell on 12 August 2005, resulting in a short period of run-off in the raised bed treatments. No surface run-off occurred on the conventional fallow treatment.

The V-notch weir is not an automated data logger and, therefore, the accuracy of the results relies on manual, visual data collection during rainfall and subsequent run-off events. The measurements were recorded during the run-off event, and the maximum flow height was identified. Using the V-notch weir flow rate correlation, the peak flow rate was calculated at 0.147 L/sec during the run-off event.

Water samples were collected from Weirs 1 and 2 during the run-off event in order to determine the sediment load of run-off water from the raised beds. This was calculated using a wet weight versus dry weight analysis.

Samples were weighed, the volume of water was calculated, and then the samples were dried at 105ºC until all water was evaporated. While the samples were still hot, they were reweighed to determine the amount of sediment in the sample.

Replicate 1 had a sediment load of 697 mg/L, while replicate 2 had a sediment load of 572 mg/L.

As no run-off occurred from the conventional fallow area, no comparisons can be drawn.

Figure 19 Water-quality trial site during run-off event. Note no run-off from fallow area

4.3.2 BSES site

A trial was established in a plant-cane block on sandy soil at BSES Mackay comparing 1.8 m duals on preformed beds to 1.5 m conventional plantings. A V-notch weir was established in each farming system to allow the project team to manually collect water samples, and record the height of run-off water at the weir. A weather station was also installed to allow for correlation with the run-off data, as well as full stop wetting front detectors to monitor deep drainage and the quality of this water. Two Isco automatic samplers were purchased in late 2005, but did not arrive and were not installed until late March.

Samples that were collected at this site and a commentary on each of the findings are detailed below.

10 January 2006

Time	10:45		11:15	
Rainfall				
Treatment	Beds	Conventional	Beds	Conventional
Flow L/sec	0.53	0	0.003	0.53
Phosphate mg/L	>2.75		>2.75	>2.75
- after 10mL dilution*	1.87		1.73	>2.75
Calculated Phosphorous of diluted	0.62		0.58	>0.92
Turbidity ntu	671		307	1100
Nitrite mg/L	0		0	0.023
Nitrate mg/L	2.1		0	0.9
Calculated Nitrogen	0.48		0	0.21

* samples were diluted with 10mL deionised water to obtain a reading

The flow rate in the beds decreased during the run-off event while it increased in the conventional system. Both systems had high phosphorous readings, but it was higher in the conventional (>0.92 mg/L after dilution). The conventional run-off water was also dirtier (1100 NTU) and had higher nitrite levels (0.023 mg/L compared to 0 mg/L). However, the conventional run-off contained no nitrate levels while the bed system recorded a higher reading of 2.1. Nitrate strip tests of the soil also indicated that the bed system had higher levels of nitrate in the top soil compared to the conventional system.

12 January

Time	9:00		9:30	
Rainfall				
Treatment	Beds	Conventional	Beds	Conventional
Flow L/sec	1.074	1.074	0.3	0.109
Phosphate mg/L	>2.75	>2.75	2.46	>2.75
- after 10mL dilution*	2.49	2.53	1.46	2.51
Calculated Phosphorous of diluted sample	0.83	0.84	0.49	0.84
Turbidity ntu	889	1100	904	858
Nitrite mg/L	0.02	0.091	0.007	0.035
Nitrate mg/L	0	0	1.9	0
Calculated Nitrogen	0	0	0.44	0

Both systems started the run-off event with similar flow rates, but the conventional system decreased quicker than the beds. Both systems had high phosphorous readings, but it was higher, and remained higher in the conventional (0.84 mg/L). The run-off water from the conventional system decreased in turbidity levels over time while the bed system remained fairly constant. The conventional water contained higher nitrite levels, while the beds contained higher nitrate levels.

27 January

Time	3:20	
Rain fall		
Treatment	Beds	Conventional
Phosphate mg/L	>2.75	2.34
- after 10mL dilution*	>2.75	1.14
Calculated Phosphorous of diluted sample	>0.92	0.38
Turbidity ntu	85	186
Nitrite mg/L	0.011	0.014
Nitrate mg/L	0.1	0.6
Calculated Nitrogen	0.02	0.14

Both systems had high phosphorous readings, but it was higher in the beds (>0.92 mg/L after dilution). The conventional run-off water was dirtier (186 NTU) and had slightly higher nitrogen levels (0.14 mg/L) than the bed system.

28 February

Time	3:00	
Rain fall		
Treatment	Beds	Conventional
Flow L/sec	0.019	0
Phosphate mg/L	2.48	
- after 10mL dilution*	1.31	
Calculated Phosphorous of diluted sample	0.44	
Turbidity ntu	39	
Nitrite mg/L	0.005	
Nitrate mg/L	0.3	
Calculated Nitrogen	0.07	

There was no run-off from the conventional system. The bed water run-off had a low flow, a reasonably high phosphorous level, with low turbidity and nitrogen levels.

9 March

Time	8:00	
Rainfall		
Treatment	Beds	Conventional
Flow L/sec	0.3	0.825
Phosphate mg/L	1.36	2.3
Calculated Phosphorous	0.45	0.77
Turbidity ntu	122	1100 and 588
Nitrite mg/L	0.002	0.061
Nitrate mg/L	0.3	0.3
Calculated Nitrogen	0.07	0.07

The conventional system had a higher flow rate than the beds. The conventional run-off water was also much dirtier (1100 NTU) and had higher nitrite (0.061mg/L compared to 0.002 mg/L) and phosphorous levels (0.77 mg/L compared to 0.45 mg/L) than the bed system. Both systems recorded the same nitrogen level of 0.07 mg/L.

Prior to this event there was a period where the bed system recorded a run-off and the conventional did not. In this subsequent run-off event the conventional run-off was of a lower quality than the bed system.

7 April – auto sampler set up to collect samples after 300 L of water run-off

Time				
Rain fall				
Treatment	Beds sample 1	Beds sample 2	Beds sample 3	Flat
Flow L/sec				0
Phosphate mg/L	2.75 limit	2.05	1.02	
- after 10mL dilution*	1.47			
Calculated Phosphorous	>0.92	0.68	0.34	
Turbidity ntu	327	1100 (886 after dilution)	1100 (1100 after dilution)	
Nitrite mg/L	0.008	0.186	0	
Nitrate mg/L	1	0	0	
Calculated Nitrogen	0.23			

There was no run-off from the conventional system. The bed system recorded a drop in phosphorous during the run-off event, while the turbidity of the water increased. The nitrite level seemed to peak at 0.186 mg/L. Nitrogen levels also dropped off as the run-off event continued.

In the beds, all calculated nitrogen levels were below the ANZEEC medium threshold of 0.8 mg/L, and half were within the low threshold of 0.2 mg/L. All calculated phosphorous levels were within the high range of 0.07-1.2 mg/L.

In the conventional system, all calculated nitrogen levels were at or below the low range of 0-0.2 mg/L. All phosphorous levels were within the high range of 0.07-1.2 mg/L.

One full-stop wetting front detector was set up in each of the systems. This was to investigate claims made in other regions that soils hold a set amount of water and, while preformed bed systems visually lose water through run-off, conventional systems lose a similar amount through deep drainage. The full stops were buried 1 m into the soil profile and collect a sample of water as it infiltrates down the profile. The full stops were installed in early March and samples were collected and analysed for phosphorous and nitrogen. Some samples were analysed using the colorimeter, while others needed to be tested using nitrate strip tests and a total reactive phosphate test because there was not enough water sample to be used in the colorimeter.

Table 20 provides a summary of the results collected from the full stops. The beds appear to record no sample, or record a sample with very high nitrogen levels, based on the ANZEEC guidelines. Over time the phosphorous levels in the bed and conventional samples decreased, but all readings were within the High category.

Table 20 Summary of full-stop data

Date	9/3/06		6/4/06		7/4/06		19/4/06		15/5/06		16/5/06	
Time	12pm		8am		8:15am		8:30am		11:45 am		4 pm	
Rainfall												
Treatment	Beds	Flat	Beds	Flat	Beds	Flat	Beds	Flat	Beds	Flat	Beds	Flat
Nitrate mg/L – colorimeter	5.5 limit	2.9	No sample	3.1	5.5 limit	0	5.5 limit	4	No sample		No sample	
And after 10mL dilution	5.5 limit											
Calculated Nitrogen mg/L	>1.27	0.67		0.71	>1.27	0	>1.27	0.92				
Nitrate strip test mg/L										25		25
Calculated Nitrogen mg/L										5.75		5.75
Phosphate mg/L – colorimeter	0.53	2.75		0.36	0.3	0.25						
Phosphate test kit mg/L							0.25	0.25		0.25		0.25
Calculated Phosphorous	0.18	0.92		0.12	0.10	0.08	0.08	0.08		0.08		0.08

4.3.3 Eton site

This ratoon-cane site was established on the farm of Gerry Deguara at North Eton. It had two row configurations, 1.5 m single rows and 2.0 m beds with dual rows. The site had been harvested green and was fourth ratoon.

A water sampler was set up to sample the water from three rows of cane in each of the treatments (Figure 20). Flumes were established in the inter-row to measure the water flow down each row and to form a pool where water could be sampled. These results are part of a large water quality project that is being undertaken by DNRW - they have not yet been made public. More information will be available when the full report from DNRW is available.

Figure 20 Water samplers set up at Gerry Deguara's farm

Run-off and water quality was measured from two treatments

- 1.5 m, single row with surface applied Liquid One Shot (160 kg N/ha) and blanket application of herbicides (Velpar 3 kg/ha; Gesapax Combi 6 L/ha)

- 2 m, dual row with sub-surface applied granular fertiliser (Nitra King S 160 kg N/ha) and 50% banded application of herbicides (same application rate as above on banded area).

The catchment area of each flume consisted of three beds, 180 m long (0.25% slope):

- 810 m^2 for 1.5 m treatment
- 1080 m^2 for 2 m treatment.

A rain gauge and tipping bucket rain gauge were located at the 2 m flume site. Rainfall intensity was recorded at 1-minute intervals, and run-off was measured from each treatment using a 300 mm San Dimas flume. Flow height in the flume was recorded at 1-minute intervals with a pressure transducer height recorder and stored on a data logger, or using an Isco Flow Bubbler module. Using the standard discharge equation for a San Dimas flume, water depth was converted to discharge.

Water quality samples were collected from each treatment using an automatic pumping sampler, with a fixed sampling arm located at the outlet of the flume. Bedload traps were installed at the entry to each flume. Due to the lack of bedload accumulation, no bedload samples were collected.

Discrete water samples were collected in 1 L glass jars at an interval equivalent to 15 mm of run-off (12150 L for 1.5 m treatment, 16200 L for 2 m treatment). Water samples were retrieved as soon as possible from the sampler, and then chilled and manually split. Each 1 L sample was manually shaken to ensure mixing and re-suspension of particulate material, and then split for sediment, herbicide, total and filtered nutrients, and total organic carbon.

Total run-off and water quality loads were calculated for each run-off event (except where sampling equipment failed, or was flooded). To calculate water quality loads for each event, concentrations were recorded in an Excel spreadsheet at the appropriate time and discharge. Concentrations were "forecast" forward to the next sample time. For the first and last samples, concentrations were forecast backward and forward to the start and end of the event, respectively. Discharge and concentrations were multiplied for each time interval and totalled to give a load for each water quality parameter. Event mean concentrations were calculated for each water quality parameter by dividing the total load with total flow.

Four run-off events were measured on both treatments, but only two were adequately sampled for water quality. The following preliminary results summary is presented comparing the 2 m beds to the 1.5 m beds across the run-off events sampled.

Run-off:

- Of the four run-off events measured, there was 30% less run-off from the 2 m beds, due in part to delayed run-off (~5 minutes) and a 30% lower peak run-off rate (mm/hr)
- Of the two run-off events where adequate water quality samples were taken, there was 12% less run-off from the 2 m beds

Sediment:

- 50% less sediment load (kg/ha), due to reduced run-off and a 44% lower event mean concentration (EMC).

Nutrients (bearing in mind the different nutrient treatments):

- Total nitrogen – 10% lower EMC, leading to 21% lower load
- Particulate nitrogen – 25% lower EMC, leading to 34% lower load
- Nitrate – similar EMC (4% higher), leading to 8% lower load
- Total phosphorus – 10% higher EMC, leading to a similar load (4% lower)
- Particulate phosphorus – 6% lower EMC, leading to 18% lower load
- Filterable reactive phosphorus – EMC 5 times higher in 2 m rows.

4.3.4 Marian site

The trial site at Marian has been monitored for 2 years both as plant cane and as a trash-blanketed ratoon crop. This site had two row configurations, 1.9 m single rows which were conventionally planted and cultivated, and 1.9 m dual rows which were planted on to preformed raised beds. Before the plant cane was established, a fallow crop of soybeans was grown. The residue from this crop was incorporated into the cultivated single row section and left on the surface in the dual-row bedded section.

The water samplers were set up to sample the water from a single row of cane in each of the treatments. V-notch weirs were established in the inter-row to measure the water flow down each row and to form a pool where water could be sampled. The area behind the weir was lined with plastic to prevent the water samplers from sucking in soil. The samplers were set to collect a sample when run-off commenced and then after each 4 mm of additional run-off occurred.

Figure 21 Logger installed in the dual-row section

Figure 22 Paired site showing the two logger installations

Figure 23 Isco water samplers installed at the Marian site

Plant cane

Water samples were collected using the Isco water samplers and processed using a field test kit. This kit has a colorimeter and was used to measure phosphate, nitrite, nitrate and turbidity levels. The phosphorous level was calculated by dividing the phosphate level by 3. The nitrogen level was calculated by multiplying the nitrate level by 0.23. Some water samples were also collected and sent to the DNRW laboratory for processing and were compared with those from the test kit. The results were compared to the ANZEEC guidelines for nitrogen and phosphorous levels.

Over the wet season all of the run-off events were monitored, but due to a few small run-off events and equipment failures only four of these events produced useful data to allow a comparison to be made between the two farming systems. Trends were:

- The single rows had lower phosphorous and turbidity levels than the dual rows
- The amount of water running off was higher in the single rows

- The nitrogen level in the single rows and dual rows was at a very high level compared to the irrigation water standard
- The nitrogen level of the single rows was almost twice that of the dual rows. (Note the soybeans were incorporated into the soil before planting the single rows and left standing in the dual rows)
- The phosphorous levels of the single rows were low compared to the guidelines
- The phosphorous levels of the dual rows were in the medium category
- Turbidity levels were high at the start of a run-off event but quickly fell to very low levels.

The results from the DNRW laboratory showed the same trends as the test-kit samples. This gave a level of confidence for the use of the test kits, and these were used for future samples.

Ratoon cane

Water samples were collected using Isco water samplers. Samples were collect each morning during rainfall events. Samples to be used for nitrate testing were preserved with PMA. All samples were then frozen and send to BSES Indooroopilly for analysis. At the time of collection, a turbidity measurement was taken using a turbidity tube

Over the wet season, all of the run-off events were monitored, but only two of these events were significant enough to produce useful data to allow a comparison to be made between the two farming systems.

Trends were:

- Nitrogen levels for both the single and dual rows were low compared to the irrigation guideline
- There was little difference in the nitrogen levels between the single and dual rows
- Phosphorous levels of the dual and single rows were in the medium category compared to the guideline
- Turbidity levels were at very low levels with little difference between single and dual rows
- Nutrient levels in the water were lower after the second rainfall event.

4.3.5 Farleigh site

At this site the grower established a row-spacing trial in 2006 that had 1.5 m conventional single rows, 1.8 m single rows, and 1.8 m dual rows planted in a preformed bed. This trial was harvested as plant cane in 2007 and was a trash-blanked first-ratoon crop when sampled. As only two loggers were available for the site, they were set-up to monitor the 1.5 m conventional rows and the 1.8 m dual rows on beds.

Figure 24 Sampling weir installed at the Farleigh site

Water samples were collected using the Isco water samplers. Samples were collected each morning during rainfall events. Samples to be used for nitrate testing were preserved with PMA. All samples were then frozen and sent to BSES Indooroopilly for analysis. At the time of collection, a turbidity measurement was taken using a turbidity tube. The results of the tests were then compared to the ANZEEC guidelines for nitrogen and phosphorous levels.

Attempts were made to capture the initial flush, as it is this initial flush that is thought to contain the highest levels of nutrients. Where rainfall events continued for several days, only one sample per day was collected after the intensive sampling on the first day. During the period of very heavy rain experienced in February where 750 mm of rain was recorded for the day no samples were collected, as the weirs were washed away. During that period, it was not possible to access the logger to repair the weirs and collect the water samples.

Over the wet season, all of the run-off events were monitored, but only two of these events were significant enough to produce useful data to allow a comparison to be made between the two farming systems.

Trends were:

- Nitrogen levels were low compared to the irrigation guidelines for both the single and dual rows
- There was little difference in the nitrogen levels between the single and dual rows
- Phosphorous levels of the dual and single rows were in the Very High category compared to the guidelines
- Phosphorous levels of the dual rows were almost twice those of the single rows
- Turbidity levels were at a very low levels, with little difference between single and dual rows.

4.4 Canegrub control

The NFS project has worked closely with the SRDC project BSS266 *Optimising canegrub management in the new cropping system.* These two projects have shared trial sites and work closely with the group of growers committed to the new farming system.

Results of grub control management strategies in the NFS will be reported in the final report for BSS266, as many of these trials are yet to be finalised.

5.0 MACHINERY LOAN SERVICE

The machinery loan service was developed to allow growers to trial the system with limited or no investment in new equipment. The project purchased sufficient equipment to allow the average grower to fully implement an area of land using the NFS project equipment.

5.1 Double-disc-opener dual-row cane planter

This dual-row double-disc-opener planter was developed by the BSES engineering group in Bundaberg and is capable of planting dual rows of cane into either flat ground or into a pre-formed bed. The double-disc-opener style of planter is also capable of planting through either cane or soybean trash in a minimum tillage situation.

This planter was used extensively in the early part of the project as growers tried a small area of the system. As confidence in the system developed, growers converted their billet planters to dual row as the labour requirement of the dual-row stick planter is quite high.

5.2 Elevator extension

The project team has had the use of three elevator extensions. Two of these have been based in Mackay and one based in the Sarina area. The elevator extensions attach to the standard harvester elevator with two bolts and two chains, making them quick and easy to attach to the harvesters.

Harvesting on a controlled traffic system has been an area of concern for a number of growers, as some harvesting contractors have been unwilling to make the changes necessary to extend the elevators to cut the wider rows. The available of an elevator extension that could be borrowed to harvest a trial overcame many of these difficulties.

As the older cane harvesters are replaced and more area is planted at wider row spacing harvester contractors are opting to use the longer harvester elevator that enables them to harvest both 1.5 m and 1.8 m rows without the use of an add-on extension.

The elevator extension proved to be a valuable tool, with each of the three elevators having harvested in excess of 50000 t of cane with no major problems.

5.3 Soybean planter

The soybean planter chosen by the project team was a 6-row Austill planter. This planter was found to be the most capable of planting soybeans through cane trash.

The planter has been used by many growers and planted hundreds of hectares of soybeans. After using the planter, six growers/grower groups have purchased similar planters for their farming systems.

The soybean planter has been used to plant both on the flat into cultivated and into old stools in sprayed-out cane blocks

5.4 Bed former

The bed former chosen by the team was a scraper type bed former with an hour-glass crumblier roller. This type of bed former works well in lighter soils or soils that have

been cultivated to a fine tilth. The scraper type of bed former is not suitable in situations where there is a lot of trash present in the soil.

The bed former has not been used extensively, but has been displayed at numerous field days and demonstrations. From these events, growers have seen how simple the machine is and have constructed their own, mostly from equipment that they already had on the farm.

5.5 Bed ripper

The Berends ripper proved to be a very useful machine. All growers have rippers, but this ripper is different in that it has ripper tynes that have an inward curve. This curve is in the legs and their shape allows the ripper legs to travel down each side of a performed bed with very little disturbance to the surface of the bed while achieving a very deep ripping action in the bed.

This ripper was also used over many hundreds of hectares and has now been modified with coulters fitted in front of the ripper legs. The ripper will receive further modification with the addition of a crumblier roller to the help control depth and break clods.

5.6 Transport trailer

The large tandem-axle trailer has been a beneficial piece of equipment, as it has allowed the project team to transport equipment to farms and field days, etc. The trailer is 4 m long and is especially suited to transporting the soybean planter.

Summary

The six items of farm machinery available to the project team have enabled them to assist growers to establish an area of the NFS on their farms with little or no capital input. The machinery has also been used extensively during field days and has assisted growers in making decision on the equipment needed for the NFS.

6.0 PROJECT EVALUATION

To evaluate the success of the project and to set directions during the life of the project, surveys and evaluations were undertaken. Surveys were targeted at two groups:

1. The growers of the NFS group
2. All of the growers in the Mackay Sugar area.

Surveys completed by growers in the NFS group were:

- An initial baseline survey that was completed at the start of the project
- A mid-project evaluation that was completed in 2006
- Grower practices and areas of land planted surveys that were completed in May 2006, November 2006 and June 2007
- A final project baseline survey that was completed towards the end of the project in May 2008.

Surveys of all growers in the Mackay Sugar area were:

- A mid-project evaluation in 2006
- A survey of growers' awareness of the project in February 2007

- A survey of the area planted to controlled traffic systems in December 2008
- A comprehensive survey of grower practices that was conducted during the shed meetings held in February-March of 2006, 2007 and 2008. These surveys were designed to assess growers' attitudes, aspirations, practice changes and knowledge

6.1 Surveys of growers in the NFS group

The baseline survey/evaluation was approached in two ways - a grower survey and a series of facilitated discussions with grower groups. The purpose of this evaluation was to gauge the knowledge, attitude, skills, aspirations and practices of growers participating in the trials (focus group) and to gauge the knowledge, attitude skills, aspirations and practices of the general growing community.

A summary of the baseline survey of the focus group is presented below. This information was used to guide the directions of the project, and to evaluate the impact of the project.

6.1.1 Initial baseline survey - summarised results

1. 68% of growers believed that *soil health* was restricting their yields. Compaction, poor soil structure and negative biology were the most common aspects of soil health that were commented on by growers in this section.

2. 35% of growers were either practicing *controlled traffic* or were implementing *controlled traffic* in plant-cane that year

3. 48% of growers practiced *break cropping*

4. 97% of growers believed that they could *improve their farming system*

5. 74% of growers believed *soil compaction* was an issue within their farming system that could be improved

6. 67% of growers believed *poor soil structure* was an issue within their farming system that could be improved

7. 48% of growers believed the *cost of production* was an issue within their farming system that could be improved

8. 55% of growers believed that *harvesting of break crops* was an issue within their farming system that could be improved

9. 45% of growers believed that *field efficiency* was an issue within their farming system that could be improved

10. 71% of growers believed that *poor soil biology* was an issue within their farming system that could be improved

12. 48% of growers believed that *new technology* was an issue within their farming system that could be improved

13. 64% of growers believed *break cropping* was an issue within their farming system that could be improved

14. 71% of growers believed that *ratoon length* was an issue within their farming system that could be improved

15. 58% of growers believed that the *number and type of cultivations* practiced was an issue within their farming system that could be improved

16. On a scale of 1-5 (1 - not important, 5 -very important) the group was asked to rate the importance of the following issues. Average scores were:
Soil Compaction – 3.6
Break Cropping – 3.8
Minimum tillage practices – 3.3
Matching row spacing to machinery wheel spacings – 4.1
Making money from your rotation crops – 3.3

17. 74% of growers had *reduced their tillage operations in the last 2 years.*

18. 45% of growers felt that they had *sufficient knowledge and skills* to implement a controlled traffic farming system with break cropping and minimum tillage practices incorporated

19. 67% of growers felt that *controlled traffic and minimum tillage practices* would reduce their cost of production (with 19% unsure)

20. 58% of growers felt that *the lack of machinery and infrastructure in the district* restricted them from harvesting their break crops (with 16% unsure)

21. 48% of growers felt that a *lack of machinery* restricted them from adopting/trialling a controlled traffic farming system

6.1.2 Facilitated discussions

The facilitated discussions were conducted with seven productivity groups in early December 2004 (approximately 80 growers). The aims of these facilitated discussions were to:

- Assess current attitudes to controlled traffic/minimum tillage/break cropping
- Assess current knowledge of controlled traffic/minimum tillage/break cropping
- Assess current barriers to adoption.

Feedback from these discussions was used to shape the following year's extension efforts. The summarised key findings from the facilitated discussions were:

- Some misconception about the cost of implementing a new cropping system
- Some lack of awareness about the cost savings offered by the system

- Some concern about dual-row cropping
- Some concern about break crops drying the soil profile and restricting cane planting
- Lack of infrastructure, equipment and knowledge for widespread adoption of grain harvesting from break crops
- Grain-growing equipment restricting controlled-traffic adoption
- Significant reductions in tillage already occurring
- Significant planting of break crops already occurring
- Some interest in 2.0 m and 3.0 m controlled-traffic systems
- Single row (wide-chute) generally more attractive than dual rows
- Some concern about the performance of disc-opener billet planters
- Improved planning by growers required – fallow selection and preparation
- Some concerns about crusting of beds and excess run-off.

6.1.3 Mid-project evaluation

To evaluate the success of the project, a simple survey was conducted with the participants of the NFS group. During this survey, information was collected about the area of NFS established, as well as the following two questions.

Q 1 Has the project benefited you?
The answer to this question was a resounding 'yes'. The growers saw two main areas of benefit:

1. The extension activities where they had the opportunity to talk to other growers about their systems and equipment and view different systems in the field
2. The availability of the project's equipment to trial the system on their own farm was seen by many as a massive benefit. The use of this equipment enabled many growers to trial the system with no or very limited capital investment. The use of the equipment also aided many growers in the selection of the equipment they require for their own farm. On a number of occasions, the loan equipment has been copied by growers.

Q 2 How could the project be improved?
Most growers offered little in the way in which the project could be improved, but a few suggestions were received:

- More variety trials in controlled-traffic situations
- Try to involve more growers who are not currently using the system. This was seen as an issue by a number of growers.

6.1.4 Surveys on growers' practices – summarised results

Three surveys were completed by the growers in the NFS group - in May 2006, November 2006 and June 2007. The aim of these surveys was to determine the level of adoption of the principles of the NFS by these growers and to identify areas where additional work was required.

Survey findings May 2006
Planting systems

- All growers are adopting a controlled-traffic row spacing
- 50% of growers are using wide-chute planters
- 25% of growers are using dual-row planters
- 40% of grower are planting in beds
- 70% of grower are using fallow legumes

Survey findings November 2006
Fallow management

- 75% of growers use plough-out to destroy old cane stools
- 25% of grower use spray-out to destroy old cane stools
- 70% of the fallow legumes are soybean
- 30% of fallow legumes are lab lab

Survey findings June 2007
Grub control

- 66% of growers are applying grub control to plant cane
- 70% apply grub control at planting
- 30% apply grub control at fill-in
- 40% apply suSCon® Blue
- 40% apply suSCon® Maxi
- 20% apply Confidor® Guard

Thoughts on the system

- 75% of growers felt that the system was working well on their farm
- 25% of growers felt that the system needed some adjustments to better suit their farm
- All growers have made some changes to the system since they began using it.

6.1.5 Final baseline survey - summarised results

1. 85% of growers believed that *soil health* was restricting their yields. Compaction, poor soil structure and negative biology were the most common aspects of soil health that were commented on by growers in this section.

2. 51% of growers were either practicing *controlled traffic* or were implementing *controlled traffic* in plant-cane that year

3. 65% of growers practice *break cropping*

4. 97% of growers believed that they could *improve their farming system*

5. 60% of growers believed that *soil compaction* was an issue within their farming system that could be improved

6. 68% of growers believed that *poor soil structure* was an issue within their farming system that could be improved

7. 68% of growers believed that the *cost of production* was an issue within their farming system that could be improved

8. 54% of growers believed that *harvesting of break crops* was an issue within their farming system that could be improved

9. 40% of growers believed that *field efficiency* was an issue within their farming system that could be improved

10. 54% of growers believed that *poor soil biology* was an issue within their farming system that could be improved

11. 45% of growers believed that *new technology* was an issue within their farming system that could be improved

12. 60% of growers believed that *break cropping* was an issue within their farming system that could be improved

13. 60% of growers believed that *ratoon length* was an issue within their farming system that could be improved

14. 62% of growers believed that the *number and type of cultivations* practiced was an issue within their farming system that could be improved

15. On a scale of 1-5 (1 - not important, 5 -very important) the group was asked to rate the importance of the following issues. Average scores were:
Soil Compaction – 4.0
Break Cropping – 3.6
Minimum tillage practices – 3.5
Matching row spacing to machinery wheel spacings – 3.4
Making money from your rotation crops – 2.5

16. 68% of growers had *reduced their tillage operations in the previous 2 years.*

17. 48% of growers felt that they had *sufficient knowledge and skills* to implement a controlled traffic farming system with break cropping and minimum tillage practices incorporated

18. 60% of growers felt that *controlled traffic and minimum tillage practices* would reduce their cost of production (19% unsure)

19. 45% of growers felt that *the lack of machinery and infrastructure in the district* restricted them from harvesting their break crops (16% unsure)

20. 58% of growers felt that a *lack of machinery* restricted them from adopting/trialling a controlled traffic farming system.

6.2 Surveys of all growers in the Mackay Sugar area

6.2.1 Mid-project evaluation

To evaluate the success of the project, a simple survey was conducted with 65 growers after a bus tour in December 2006. As a general invitation was extended to the industry to attend the bus tour, both growers who were part of the NFS group and growers who were not attended the event. The survey was carried out by staff as they mingled with the group after the bus tour. Six questions were put to the group.

Q 1 Are you aware of the New Farming Systems project?
100% of the growers surveyed were aware of the New Farming Systems project.

Q 2 Has the information provided by the project been useful in making your decision to move to the New Farming System?
100% of the growers responded that the information they received was useful in decision-making.

Q 3 Do you have any cane on your farm planted to a controlled traffic system?
66% of the growers surveyed had planted an area of cane on a controlled-traffic farming system.

Q 4 Have you grown any fallow legumes on your farm?
85% of the growers had grown fallow legumes on their farm.

Q 5 Are you aware of the equipment available through the project?
95% of the growers were aware of the equipment available for use through the project.

Q 6 Have you used any of the equipment?
50% of the growers had used some of the equipment on their farm.

The survey shows most growers were aware of the project and could see the benefits of the project. Growers saw that the greatest benefits were the information provided by the project and the use of the project equipment to trial the system. Of interest was that 95% of growers were aware of the equipment, but only 50% had used the equipment. This indicated that many growers had purchased their own equipment to establish the NFS. Although 66% of growers had a controlled-traffic farming system on their farm, 85% had grown fallow legumes. This means that some components of the NFS were being adopted more rapidly than others.

6.2.2 Grower awareness of the project

During the February 2007 round of shed meetings we surveyed growers' practices. These detailed surveys were conducted with all grower groups in the Marian and Farleigh mill areas, as well as with several groups in the Racecourse and Pleystowe mill areas. 183 growers were surveyed.

The two questions that were designed to determine grower's awareness and participation in the New Farming System Project were:

1. *Are you aware of the BSES "New Farming System's" project looking at fallow legumes and controlled traffic?*
   95% of growers indicated that they were aware of the project.

2. *Have you attended a New Farming Systems field day, bus trip or discussion group?*
   32% of growers indicated that they had been involved in a NFS activity.

6.2.3 Area planted to controlled-traffic farming systems

The Mackay Area Productivity Services collects planting details from all growers in the region each year, including the row spacings used by growers. Figure 25 shows the blocks that were planted in 2007 at a row spacing of at least 1.8 m in red (1936 ha) with the cane-growing region in green. The records also show that about 40 growers or 5% of the growers in the Central district were actively using the entire NFS on their farms. Many more growers are using only one component of the system, such as fallow legumes.

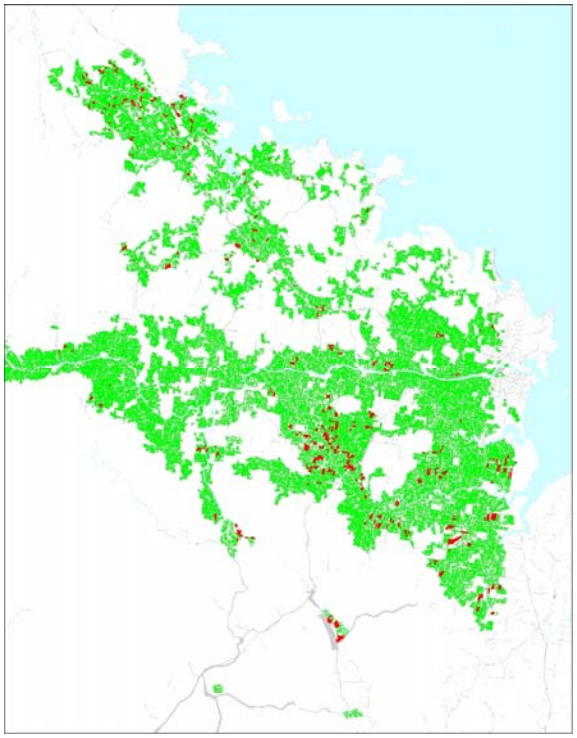

Figure 25 Distribution of fields planted in 2007 (in red) to wider row spacings

Other points to note from the map:

- Controlled traffic blocks were distributed across the region
- There was a concentration of controlled-traffic systems in the North Eton and North coast regions
- Controlled-traffic systems were more limited in the upper Pioneer Valley and the southern end of the Farleigh mill area. These regions are typically hillier with smaller farms and broken country.

The achievement criterion of 1000 ha planted to NFS was exceeded, with almost 2000 ha planted in the Mackay region in 2007 alone, with additional areas planted in the Sarina and Proserpine regions. In total, the Mackay region has over 5000 ha of cane grown on controlled-traffic systems with row spacings of 1.8 m or more.

6.2.4 Surveys of growers' practices

Comprehensive surveys of growers' practices were conducted during the shed meetings held in February-March of 2006, 2007 and 2008. The surveys were designed to assess growers' attitudes, aspirations, practice changes and knowledge, and covered more than just NFS-related issues. During the 2006 round 193 growers completed the survey, 273 growers completed the survey in 2007, and 112 growers completed the survey in 2008.

Each survey was extensive and took the form of a question on a theme and then a series of tick boxes for the grower to rate his/her practices. Table 21 summarises the survey questions and responses that were applicable to the NFS project:

- Approximately 70% of growers believed they have optimised most areas of their farming system, but still had the ability to improve on controlled-traffic systems, with only 25% of growers having optimised controlled-traffic systems and 40% of growers having optimised rotational crops
- 64% of growers were confident of accessing soil health conditions
- Only 14% of growers were using controlled traffic with GPS, but this increased from 9% in 2007
- Plough-out/replant was still a common practice, with 68% of growers using this practice.

Table 21 Summary of survey results

			2008			2007			2006	
			No.	**%**		**No.**	**%**		**No.**	**%**
6. In your current farming practice do you consider that you have optimised the following?	Fallow management	n	40	33%		97	37%		4	2%
		y	81	67%		162	63%		168	98%
	Nutrient management	n	33	29%		85	33%		6	4%
		y	79	71%		169	67%		159	96%
	Weed control	n	29	25%		53	21%		2	1%
		y	88	75%		204	79%		168	99%
	Pest management	n	32	29%		78	31%		5	3%
		y	80	71%		177	69%		161	97%
	Laser leveling and drainage	n	43	37%		110	43%		38	25%
		y	73	63%		145	57%		114	75%
	Irrigation	n	52	46%		93	37%		22	14%
		y	61	54%		156	63%		138	86%
	Selection of varieties	n	32	28%		55	22%		1	1%
		y	83	72%		197	78%		170	99%
	Planting methods	n	39	35%		90	36%		30	19%
		y	73	65%		159	64%		129	81%
	Farm Layout e.g. row length	n	20	17%		53	21%		15	10%
		y	100	83%		201	79%		140	90%
	Controlled traffic	n	85	75%		200	79%		95	65%
		y	28	25%		52	21%		52	35%
	Rotational crops	n	74	60%		169	67%		60	38%
		y	50	40%		84	33%		98	62%
	Tillage practices	n	43	37%		85	34%		23	15%
		y	74	63%		166	66%		132	85%
	Addressing soil health	n	41	36%		91	36%		6	4%
		y	73	64%		163	64%		157	96%
8.Which of the following are currently practiced on your farm?	GPS Controlled traffic (Guidance	n	95	86%		235	91%			
		y	15	14%		24	9%			
	Rotational cropping	n	68	61%		170	66%		90	55%
		y	44	39%		86	34%		73	45%
	Minimum tillage practices	n	64	56%		187	72%		17	10%
		y	50	44%		72	28%		154	90%
	Permanent Beds	n	94	90%		231	90%			
		y	11	10%		26	10%			
	Cutaway (plant cane) treatments	n	31	27%		66	25%			
		y	85	73%		193	75%			
	Plough out replant	n	38	32%		106	41%			
		y	80	68%		155	59%			
	Matching row spacing to machine width (wheel spacing)	n	49	43%		129	50%		83	50%
		y	65	57%		129	50%		82	50%
	Making money from rotational crops	n	89	79%		242	92%		134	83%
		y	24	21%		20	8%		28	17%
	Precision farming (site specific crop management)	n	80	76%		224	86%		112	69%
		y	25	24%		35	14%		50	31%
9. Do you manage nutrient input by conducting regular soil analysis (at least fallow blocks annually)?		n	31	27%		107	41%		56	30%
		y	84	73%		156	59%		133	70%

6.3 Summary

During the life of the project, 13 grower surveys were completed. These surveys gave the project team a clear understanding of the practices being undertaken by the growers in the project. Of interest is that 75% of growers felt that the system was working well on their farm and all growers were still making changes to the system. These changes will lead to improvement to the system and a higher level of satisfaction with the system.

The surveys found that most growers were aware of the project and saw the benefits of the project. Growers saw the greatest benefits as the ability to mix with other growers who are trialling the new system, as well as the use of the project equipment to trial the system.

During the surveys little was offered in the way of improvement that could be made, the only two offered were to conduct more variety trials and to try to involve more growers who are not currently using the system. Of interest was that 95% of growers were aware of the equipment, but only 50% had used the equipment. This indicated that many growers had purchased their own equipment to establish the NFS. Although 66% of growers had a controlled-traffic farming system on their farm, 85% had grown fallow legumes. This means that some components of the NFS were being adopted more rapidly than others.

Surveys of the area planted to the controlled-traffic system show that significant planting have been made with about 2000 ha planted in the 2007 season representing 20% of the planted area. The total area farmed using a controlled-traffic system was about 5000 ha in 2007.

7.0 OUTPUTS

The most significant outputs of the project are two publications to aid growers in the adoption of the system.

1. *Growing soybeans in a cane rotation*. This 8-page booklet was published in 2005 to aid growers in the growing of fallow legume crops
2. The system ‘change over kit’. This kit took the form of a special edition of the *BSES Bulletin* (issue 18) and contained information on the various pieces of equipment necessary for the adoption of the new farming system.

In addition, the project has increased awareness and adoption of the NFS. This is well documented in Section 6.

8.0 EXPECTED OUTCOMES

This project has led to an increased adoption of the principles of the NFS. During the life of the project, surveys have shown adoption levels of controlled traffic have increase from very low levels to around 20% of the area planted now being planted on a controlled-traffic system.

As the project has been an extension project working with growers, it is expected that the learnings from the project will not be lost but will continue to be used by the growers who were involved in the project. These learning should result in additional areas being established using the principles of the NFS.

9.0 FUTURE NEEDS AND RECOMMENDATIONS

- The change initiated by this project needs to be continued to support the remaining 80% of growers who have not yet adopted the NFS
- BSS306 and the newly proposed project "Bridging the extension chasm" aim to assist growers as they move to the NFS or to the next step in the farm system to zonal tillage - these projects should be supported
- The farming system should no longer be called the 'New Farming System' as it is now a proven system on many farms.

10.0 PUBLICATIONS ARISING FROM THE PROJECT

Various *BSES Bulletin* articles in issue 18, 19 and 20 have outlined the findings of the project:

- Choosing the right bedformer
- Soybean planters used in the New Farming System
- Growing soybeans in a cane rotation in Queensland's Central region
- What type of cane planter will you use?
- Harvester modifications to cut wider row spacings
- GPS selections tips
- New Farming System – a case study from the deep south
- Zonal tillage gaining momentum – a case study from the Central region
- Increasing viability with reduced growing costs
- Field day showcases green cane trash blanketing and new farming system

11.0 ACKNOWLEDGMENTS

Thanks go to:

- The growers of the Central district which have worked with the project team to allow this project to be success that it has been
- BSES Limited, QDPI&F and DNRW staff who have worked with the project team
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