

# Sugarcane Improved Practices Guide: Burdekin

2016



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# Using This Guide

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## Introduction

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The introduction contains three sections. They include and discuss:

1. **Burdekin Sugarcane Production:** this section provides an overview of the region's environmental conditions that affect sugarcane production and business.
2. **Whole of System Farming:** this section gives an overview of the improved practices in this document and gives a brief outline of how they impact on the farm's productivity, profitability and sustainability.
3. **Whole of System results:** this section provides results of any case studies, trials, and reports that have used the entire 'whole of system' approach on sugarcane farms in the Burdekin.

## Practices

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### Practice Overview

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Within each improved practice, there is a simple layout so that you can find the information you need quickly. Each section is divided into two main areas including 1) practice overview and 2) results. The practice overview content describes:

- **Practice Name** (e.g Irrigation): the area of the farm system to implement the improved practice
- **Best Practice:** the recommended practice to improve productivity, profitability and sustainability. This is followed by a description of the practice and the technical and scientific reasoning for taking up the practice
- **Rules of thumb:** a set of actionables to follow when implementing the improved practice
- **How the practice affects profitability and productivity:** a discussion of impacts and implications for productivity and profitability on farm if the improved practice standard is not met
- **Potential benefits for your farm:** an overview of potential benefits that could be achieved in theory at a whole of system and business scale. The actual benefits will be different depending on current practices and we recommend contacting our extension staff to tailor practices to your farm

## Results

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The results section of each practice includes and provides:

- **Real Results:** Presents the results of using the best practice on sugarcane farms in the Burdekin. The studies describing the practice, method, and results in full are available by following the reference
- **Water quality and environmental benefits:** in addition to the profitability and productivity results, this section provides an overview of the need to reduce environmental impact with specific impacts from sugarcane in the Burdekin. It also lists environmental outcomes from the studies if available
- **Resources:** A list of resources (linked to websites) that provides all the referenced studies and any additional resources that would be helpful for using the practice on farm in the Burdekin

## Burdekin Sugarcane Production

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The Burdekin region is referred to as the sugar capital of Australia, and the local sugarcane growing industry supports a prosperous rural community **(1)**. The unique environmental conditions of the area are characterised by less rainfall than the northern area of the Wet Tropics. This means the industry relies on water sourced from the river systems, underground and surface supplied water from Sunwater. The Burdekin is commonly split into two areas of irrigation. The Burdekin River Irrigated Area (BRIA) and the Delta. The Burdekin catchment area flows into the Great Barrier Reef. In these environmental conditions, sugarcane farming in the Burdekin has the unique requirements of:

- Manual irrigation due to little rainfall
- Higher district yield potential
- Laser levelling to get the required slope for irrigation water to run to the end of the paddock
- Larger paddock sizes and longer drills to better manage harvesting operations
- Drainage channels on farm to manage runoff and reduce water logging from irrigation
- Larger harvester groups of 100,000 tonnes or more
- Cane is burnt prior to harvest
- Wheel driven harvesters are preferred over track driven
- Flatbed trucks are used as haul outs as opposed to tractor driven tippers because sidings can sometimes be several kilometres away from harvested paddocks

These factors should be taken into consideration when applying improved practices to farming systems. Looking at the business as a whole will get the best resource use efficiency.

## Whole of System Farming

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This document outlines areas of sugarcane farming systems in which farmers can improve practices to gain productivity, profitability and sustainability benefits. The areas of improved practices include:

- [Irrigation](#)
- [Soil runoff and landscape management](#)
- [Fertiliser and nutrient application](#)
- [Controlled traffic and minimal tillage](#)
- [Legume and crop fallows](#)
- [Pests and weed management](#).

The areas contain information on how each practice can be managed to improve farm productivity, profitability and sustainability. Each practice area presents results and evidence of the practices in use from sources such as case studies, economic studies and trials that have been carried out as a proof of concept.

Each practice area contains a 'rules of thumb' section which provides actionables for implementing the improved practices. A whole of farming system approach requires each practice to be addressed individually, so they can work together to improve all aspects that impact on sustainability and profitability. By moving towards a whole of farming system approach increased productivity, profitability, and sustainability can be achieved.

[Extension officers](#) are available in all cane farming areas and are skilled in helping implement these changes on farm. Contact information for extension services is at the end of this guide.

## Whole of System Farming Results

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There are expected economic benefits for farmers in transitioning towards a system of improved management practices. This is based on economic analyses that have been undertaken on sugarcane farming system practices in the Burdekin.

Economic analyses have shown that it is possible for a farming enterprise to improve profitability whilst operating with improved management practices. It is recommended that you assess your specific farming circumstances before undertaking any practice changes. As a result of making improvements on farm, productivity outcomes will also result in water quality improvements. This will have a positive impact on farmer image when improvements are detected on the Great Barrier Reef.

Generally, on farm efficiency can provide both a productivity, environmental, and profitability gain whilst disregarding fluctuations in commodity prices. By growing cane more efficiently with reduced inputs and labour costs growers will gain immediate benefits in profit margin as well as environmental gains from reduced waste or loss.

Economic analyses of demo farms in the Burdekin region have indicated that adopting



improved management practices may be economically viable. Benefits included a higher gross margin and positive net present value. This was demonstrated when a farm transitioned from C class to B class management practices over a five to 10 year period. **(2 & 3)**

### *References & Resources*

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**(1)** [Burdekin Shire Council \(2016\). About the Area. Ayr. Viewed July 15<sup>th</sup> 2016 <http://www.burdekin.qld.gov.au/community/visitor-information/about-the-area/>.](http://www.burdekin.qld.gov.au/community/visitor-information/about-the-area/)

**(2)** [Poggio, M. and Page, J. \(2010\), Economic case study of ABCD cane management practices in the Burdekin River Irrigation Area \(BRIA\) region. Department of Employment, Economic Development and Innovation, Queensland. http://era.daf.qld.gov.au/3123/.](http://era.daf.qld.gov.au/3123/)

**(3)** [Poggio, M. and Page, J. \(2010\) Economic case study of ABCD cane management practices in the Burdekin Delta region. Department of Employment, Economic Development and Innovation, Queensland. http://era.daf.qld.gov.au/3124/.](http://era.daf.qld.gov.au/3124/)

[Collier, A., Poggio, M., Holligan, E. & Renouf, M. \(2015\). The impact of sugarcane growing practices on farm profitability and the environment – a literature review. Report to the Sugar Research Australia project 2014/15 \(Measuring the profitability and environmental implications when growers transition to Best Management Practices\). State of Queensland \(30pp\).](#)

[Van Grieken, M., Poggio, M., Smith, M., Taylor, B., Thorburn, P., Biggs, J., Whitten, S., Faure, C., and Boullier, A. \(2014\). Cost-effectiveness of management activities for water quality improvement in sugarcane farming. Report to the Reef Rescue Water Quality Research & Development Program. Reef and Rainforest Research Centre Limited, Cairns \(85pp.\).](#)

# Irrigation

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## Best Practice: Scheduled irrigation

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Irrigation volumes should match the requirements of the crop. You should consider:

- Amount of water needed by the plants by evaluating the age of the plant in conjunction with evapotranspiration and soil moisture content
- How often you apply it (frequency)
- Timing of irrigation events with application of fertiliser and ameliorants such as mill mud.

Accurate scheduling of irrigation events can reduce water costs, decrease the instance of denitrification losses, and prevent excessive runoff on farm which could potentially be carrying sediment, nutrient and pesticides with it.

Soil moisture monitoring equipment, such as tensiometers, can help you schedule how often to irrigate and how much water you need to apply. There are many sensors that can be purchased off the shelf and installed on your farm for a relatively low cost. Our [extension staff](#) can also assist you.

You can also access further information about scheduled irrigation, tensiometers and other useful irrigation resources at [Sugar Research Australia's website](#).

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## Rules of Thumb

- ✓ Schedule irrigation to match water required by the crop. Excess water can lead to deep drainage, leaching, run off, compaction, water-logged soil, etc
  - ✓ Take advantage of scheduling tools and new irrigation technology that can increase on farm efficiency
  - ✓ Schedule irrigation to coincide with cheap tariffs
  - ✓ After harvest wait till the second irrigation event to fertilise the crop
  - ✓ Apply fertiliser at appropriate times taking into consideration wet season rainfall events
  - ✓ Refer to and follow label instructions, noting any withholding or incorporation periods
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## How Irrigation Affects Your Farm's Productivity and Profitability

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The main areas that soil runoff and land management can impact your farm's productivity and profitability are:

- Irrigation amount, frequency, and timing with other irrigating events
- Electricity tariff timing
- Timing with other activities e.g. applying fertilisers, harvesting etc.

Over irrigating after planting can create an anaerobic environment and impact plant strike. Not only can excess irrigation cost more money in both pumping costs and water costs, it can attribute to fertiliser losses both in surface runoff, denitrification (water logging) and deep drainage. This is money lost from the farmer's pocket as well as attributes to poor plant growth from lack of available nutrients.

Irrigation system type can have varied degrees of impact – excessive flood irrigation can cause water logging which leads to lower yields and denitrification losses. Overhead can cause surface crusting which reduces germination and infiltration.

Irrigation or rainfall events that coincide within the first few weeks of fertiliser application generally attribute to higher nitrogen losses. It is recommended to apply fertiliser after the first or second irrigation event as opposed to behind the harvester.

Flood irrigation scheduling and irrigation cycles can be difficult to keep on top of and in some cases they do not coincide with timings convenient to the grower. It is important to be aware of the tariffs in place and the timings of irrigations to take advantage of the cheaper electricity prices. Maintaining pumps and fluming to ensure that the flow is not impeded or slowed improves irrigation efficiency and can decrease irrigation times. Surge irrigation can help growers with longer drills to irrigate the crop sufficiently without excessive run times of over 24 hours.

## Potential Benefits for Your Farm

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If practices are tailored to suit your farm's systems, scheduled irrigation may provide many benefits to your profitability and productivity. Possible benefits may include:

- Water and electricity savings
- Decreased irrigation labour and vehicle operation costs
- Efficiency savings from fertigation where possible
- Fewer nutrients lost from reduced deep drainage, water runoff and denitrification
- Increased yields from better water and nutrient uptake in plants.

We recommend you [contact one of our extension staff](#). They can help you determine which of these benefits are possible for your farm by modifying your farm's irrigation systems.

Case studies and trials where growers have realised some of these benefits are detailed in the following section.



## Real Results

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Several irrigation methods have been trialled on sugarcane farms in the Burdekin. Studies and economic modelling of the practices and methods showed the following results:

### Low Cost Drip Irrigation

Low cost drip irrigation used in the Burdekin case studies had overall lower growing costs and reduced water use and runoff, but high initial investment costs **(1)**. Assessments of your own farm with the help of [extension staff](#) will let you determine if this system is appropriate.

### Telemetry and Automation for Furrow Irrigation

The telemetry and automated furrow trial in the Burdekin found savings from lower electricity use, water and labour requirements **(2 & 3)**. Growers also recognised lifestyle improvements from using this technology **(4)**.

### Pump Efficiency Evaluation

[Pump evaluation figures in the Burdekin](#) and [tools for tariff calculating](#) are available from Sugar Research Australia and CANEGROWERS websites.

### Overhead Low Pressure Irrigation - Lateral Move Irrigators

Overhead low pressure irrigation was trialled on a lower Burdekin farm in 2007. It replaced the furrow irrigation system. The farm also used new practices and green cane trash blanketing **(5)**.

Environmental and social benefits were achieved, but the high capital costs and other factors made the project economically non-beneficial. It may have been economically beneficial if the value of water saved was realised by the business **(5)**.

## Water Quality and Environmental Benefits

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Major water quality and environmental threats from sugarcane farms in the Burdekin are:

- Nutrient and nitrogen fertiliser run-off
- Pesticide run-off
- Sediment run-off. **(6)**

Using the practices can help landholders reduce these impacts and implement the [Reef Water Quality Protection Plan 2013](#). Growers must continue to comply with the [Environmental Protection Act 1994](#) and other Biosecurity Queensland Acts. For further information about meeting the regulations visit the [Reef protection regulations webpage](#).

## Improving Your Water Quality

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Practising correct irrigation scheduling and refining irrigation application efficiencies to match the crop requirement will help to reduce run-off from your farm. This means less run-

off pollution from fertiliser, nutrients, pesticides, and sediment.

### *References & Resources*

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- (1) Thompson, M., Shannon, E., and McDonnell, P. (2015). Low cost drip irrigation in the Burdekin: Representative economic analysis. Department of Agriculture and Fisheries (DAF), Queensland.
- (2) Thompson, M., McDonnell, P., and Shannon, E. (2015). Telemetry and automation for furrow irrigation in the Burdekin: Representative economic analysis. Department of Agriculture and Fisheries (DAF), Queensland.
- (3) [NQ Dry Tropics \(2015\). Case Study Willy Lucas, Townsville \(online\). Viewed July 15<sup>th</sup> 2016 <https://drive.google.com/file/d/0BwSfEIDILIEZM21QbWI5Qk5JNzg/view?pref=2&pli=1>.](https://drive.google.com/file/d/0BwSfEIDILIEZM21QbWI5Qk5JNzg/view?pref=2&pli=1)
- (4) [NQ Dry Tropics \(2015\). Aaron Linton Final Case Study Dec 2015 \(online\). Viewed 20<sup>th</sup> July 2016. <https://drive.google.com/a/nqdrytropics.com.au/file/d/0BwSfEIDILIEZbXQ4RONKTHQ1RFk/view?pref=2&pli=1>](https://drive.google.com/a/nqdrytropics.com.au/file/d/0BwSfEIDILIEZbXQ4RONKTHQ1RFk/view?pref=2&pli=1)
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- (6) [Queensland Government \(2016\). Great Barrier Reef – Final Report \(online\). Viewed 25<sup>th</sup> July 2016. Available: <http://www.gbr.qld.gov.au/taskforce/final-report/>](http://www.gbr.qld.gov.au/taskforce/final-report/)

# Soil Runoff and Land Management

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## Best Practice: Manage headlands, vegetation buffers, drains and sediment traps to reduce runoff pollutants from crop areas

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Vegetated filter strips and grass buffers are effective for reducing and trapping sediment and nutrients leaving paddocks. Riparian buffer strips can also help to reduce stream bank erosion, and provide wildlife habitats and landscape connectivity. **(1)**

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### Rules of Thumb

- ✓ Use vegetation, sediment traps and wetlands to reduce soil runoff and manage landscape features such as stream banks, headlands, gullies, drains
- ✓ Maintain vegetation on headlands and adhere to riparian zone when applying herbicides – these are outlined on the label
- ✓ Maintain recycle pit levels as low as possible to reduce deep drainage and allow for maximum capture of runoff generated by irrigation or rainfall

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### How Soil Runoff and Land Management Affects Your Farm's Productivity and Profitability

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The main areas that soil runoff and land management can impact your farm's productivity and profitability are:

- Erosion damages soil profile and can create low lying areas leading to waterlogging
- Poor water quality – chemicals and fertiliser can be bound to soil particles in runoff
- Damage to tractors and machinery
- Dirt in harvested crop may lead to penalties from the mill
- Poor traffic areas for harvesting and haul out equipment creating issues during the crush
- Recycling water reduces irrigation costs and captures and reuses chemical and nutrient within the runoff water back on the paddock

Maintaining vegetated filter strips and grass buffers is important when frequent heavy vehicles traffic the headlands of a farm. Without grass coverage on the headlands erosion of

soil is more likely in runoff events caused by excessive irrigation or rainfall. Maintaining wide headlands increases harvesting and haul out efficiency. If you are close to a riparian area or local creek it is important to abide by label recommendations on selected herbicides. Turning off the spray rig when approaching the end of the paddock reduces spray drift and herbicides being readily available to run off.

## Potential Benefits for Your Farm

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If practices are tailored to suit your farm's systems, soil runoff and land management may provide many benefits to your profitability and productivity. Possible benefits may include:

- Reduced need to laser level in the fallow
- More efficient harvester operations and lower dirt readings at the mill
- Increased water quality and irrigation savings from capturing and reuse of runoff water
- Recycle pits collect runoff from the farm for reuse. This saves in irrigation costs whilst capturing sediment, nutrient and pesticide runoff

We recommend you [contact one of our extension staff](#). They can help you determine which of these benefits are possible for your farm by modifying your on farm soil and land management.

Case studies and trials where growers have realised some of these benefits are detailed in the following section.

## Real Results

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These practices have been implemented on farms in the Burdekin, but no economic analyses are available at this time. [Contact an extension officer](#) for further information about this practice.

## Water Quality and Environmental Benefits

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Major water quality and environmental threats from sugarcane farms in the Burdekin are:

- Nutrient and nitrogen fertiliser run-off
- Pesticide run-off **(4)**

Using the practices can help landholders reduce these impacts and implement the [Reef Water Quality Protection Plan 2013](#). Growers must continue to comply with the [Environmental Protection Act 1994](#) and other Biosecurity Queensland Acts. For further information about meeting the regulations visit the [Reef protection regulations webpage](#).

## Improving Your Water Quality

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Trials on other horticultural farms have shown that vegetated strips are effective at lowering sediment and chemical runoff from farms. Trials on a banana farm in the Johnstone River catchment have shown that grass buffer/filter strips were able to reduce the sediment levels in runoff leaving the farm by more than 80 per cent. Decreases in nitrogen, phosphorus and suspended sediment were also recorded with levels between 25 per cent and 65 per cent. **(2 & 3)**

### *References & Resources*

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- (1) [Prosser, I. and Karssies, L. \(2001\), Designing filter strips to trap sediment and attached nutrient, River and Riparian Land Management technical guideline, Number 1, May 2001. Land and Water Australia, Canberra.](#)
- (2) [McKergow, L.A. and Prosser, I.P. and Greyson, R.B. and Heiner, D. \(2004\), Performance of grass and rainforest riparian buffers in the wet tropics, Far North Queensland 1 Riparian Hydrology, Australian Journal of Soil Research, Volume 42, pp. 473-84.](#)
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# Fertiliser and Nutrient Application

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## Best Practice:

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1. Match nutrient and fertiliser application amounts to plant requirements
2. Apply fertiliser subsurface

Match nutrient amount/rate to your crop's needs by varying application rates and timing between blocks. Use soil tests, crop class, cane variety, soil type, block history, soil conditioners and yield expectations to determine the nutrient rate that is required to grow the best crop possible.

Subsurface application of fertiliser via stool splitter is best practice for applying fertiliser for uptake by the plant roots whilst decreasing the chances for loss pathways such as denitrification, volatilisation, deep drainage and surface runoff. Sufficient coverage of the fertiliser is important for reducing volatilisation loss.

Application techniques you can use include subsurface (under the soil surface), stool-splitters, and side dressers in the plant and ratoon crop. It is important to get proper soakage into the top of the hill when using granular fertilisers. Water infiltration may be reduced due to compaction resulting in reduced fertiliser uptake.

Split nitrogen applications may assist in better nutrient uptake by the crop. This is easily achieved in drip irrigation systems which utilise fertigation however some growers chose to apply granular nitrogen in split applications in ratoons. Fertigation only benefits water quality if it is part of an integrated nutrient management plan. This plan will take into account the physical and chemical properties of soil, yield potential, block history and possible loss pathways. **(1, 2 & 3)**

You can access useful resources for [calculating application rates with 6 EASY STEPS](#) and [keeping chemical records](#) from the Sugar Research Australia and CANEGROWERS websites.



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## Rules of Thumb

- ✓ Follow [6 EASY STEPS](#) and label instructions to calculate how much fertiliser and nutrients you should apply. Additional fertiliser applied above six easy steps has the potential to be lost through a variety of pathways as opposed to being used by the plant. If you have trouble calculating this, an [extension officer](#) can help
- ✓ Time fertiliser and nutrient applications according to the irrigation schedule and rainfall forecast
- ✓ Apply fertiliser and nutrients under the soil surface close to the roots of your plant with sufficient coverage to minimise the chance of losses and maximise the uptake from the plant
- ✓ Follow the label instructions for the chemical that is being applied

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## How Fertiliser and Nutrient Application Affects Your Farm's Productivity and Profitability

The main areas that fertiliser and nutrient application can impact your farm's productivity and profitability are:

- Legume fallows – lower N requirements
- Fertiliser price and rate
- Plant requirements
- Irrigation and rainfall timing events attribute to losses

Excess fertiliser application can have negative impacts on Commercial Cane Sugar (CCS) at harvest. Fertiliser applied that is not taken up by the plant is nearly always lost through one of several pathways which attribute to profit loss. To minimise wasted money and fertiliser waste, soil sampling should be conducted at a block level to determine nutrient rates whilst also taking into account, yield potential, block history, and possible loss pathways. This is the best method to ensure that you can minimise fertiliser loss and profits. Growers should consider reducing nitrogen rates based on the age of their ratoon crops. Ratoons older than 2<sup>nd</sup> or 3<sup>rd</sup> should have a lower rate of nitrogen application and the crop potential has decreased in the subsequent ratoons. Applying nutrients when there is minimal risk of adverse weather events will prevent major losses, as well as applying the fertiliser once the crop has emerged from the ground and has a sufficient root system to be able to grow and photosynthesise. **(3, 4, 5, 6 & 7)**

Targeted soil and leaf testing are cost effective tools for figuring out nutrient amounts, and testing can be tailored to the needs of the crop. After each rotation of cane a soil test should be obtained before plant to best determine how to manage the designated block. If a legume crop was planted during the fallow a soil test after these rotational crops can assist

in determining a reduced nitrogen rate which takes into account additional soil organic nitrogen that has been added by the legume. It is important to record your fertiliser application and rates over the life of the crop. This also serves as a business tool in assessing your farm's profitability. **(8)**

## Potential Benefits for Your Farm

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If practices are tailored to suit your farm's systems, improved fertiliser and nutrient application may provide many benefits to your profitability and productivity. Possible benefits may include:

- Decreased labour and tractor operation costs in a fertigation system
- Reduced losses of applied nutrients through deep drainage and runoff
- Increased yields from better nitrogen use efficiency in the cane plant
- Savings from reduced nitrogen rates following a legume crop
- Savings from reduced nitrogen rates when tailoring applications to soil tests and crop yield potential in later ratoons

We recommend you [contact one of our extension staff](#). They can help you determine which of these benefits are possible for your farm by modifying your on farm nitrogen management.

Case studies and trials where growers have realised some of these benefits are detailed in the following section.

## Real Results

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Several fertiliser and nutrient application methods have been trialled on sugarcane farms in the Burdekin. Studies and economic modelling of the practices and methods showed the following results:

### **Variable Rate Fertiliser Application via Prescription Map**

Using variable rate technology for applying fertiliser and other inputs can give multiple benefits including economic benefits of cheaper inputs, such as fertiliser savings, and better crop yield. [More information about this method](#) is available from Sugar Research Australia.

### **Enhanced Nitrogen Efficiency/EEN Fertilisers**

The early results indicate using controlled release fertilisers at rates 40 and 60 kilograms of nitrogen per hectare lower than the base scenario would require a yield increase of between one and nine tonnes of cane per hectare to breakeven. In comparison, using ENTEC® with similar reductions in nitrogen rates would allow a buffer of up to 1.5 tonnes of cane per hectare decline in yield **(9)**.

Multiple growers in the Burdekin conducted trials of EEN fertilisers and have found no significant differences in productivity across treatments. For full details refer to the case

studies in the resources list. **(9, 10, 11, 12, 13 & 14)**

Sensitivity analyses of the breakeven yield to changes in the price of EEN fertilisers found that the controlled release fertiliser treatments were more price sensitive than the ENTEC® treatments **(9)**.

### **Mill By-products & Ameliorants**

Banding mill mud at 65t/ha instead of 200t/ha could provide annual savings between \$18 and \$106/ha over one crop cycle. This was calculated in a growing cost analysis with assumptions stated in the study. The large difference between sites is mainly due to distance from the mill and potential fertiliser cost savings **(15)**.

## Water Quality and Environmental Benefits

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Major water quality and environmental threats from sugarcane farms in the Burdekin are:

- Nutrient and nitrogen fertiliser run-off
- Pesticide run-off
- Sediment run-off **(16)**

Using the practices can help landholders reduce these impacts and implement the [Reef Water Quality Protection Plan 2013](#). Growers must continue to comply with the [Environmental Protection Act 1994](#) and other Biosecurity Queensland Acts. For further information about meeting the regulations visit the [Reef protection regulations webpage](#).

## Improving Your Water Quality

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Implementing improved fertiliser and nutrient application including irrigation timing, calculated amounts, and application timing will help to reduce run-off from your farm. This means less pollutants leaving the farm through one of many potential pathways. Environmental benefits of using these practices include:

- Less fertiliser applied with more efficient application techniques
- Decreased dissolved inorganic nitrogen (DIN) loads on the Great Barrier Reef
- While applying mill mud can provide soil health benefits, banding mud directly on the cane row helps lower application costs and may decrease nutrient runoff **(5)**
- Applying a reduced rate of nitrogen following legumes can decrease planting costs and reduce the amount of inorganic nitrogen susceptible to loss pathways

## References & Resources

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- (1) [Thorburn, P.J. and Dart, I.K. and Biggs, I.M. and Baillie, C.P. and Smith, M.A. and Keating, B.A. \(2003\). The fate of nitrogen applied to sugarcane by trickle irrigation, Irrigation Science, Volume 22, Number 3-4, pp. 201-09.](#)
- (2) [Prove, B.G. and McShane, T.J. and Reghenzani, J.R. and Armour, J.D. and Sen, S. and Moody, P.W. \(1996\), in Bond, W.S. \(ed\) Occasional paper 08/96 Measurement and Management of nitrogen losses for groundwater protection in agricultural production systems, Workshop proceedings held in conjunction with Water Downunder 94, the 25th Congress of the International Association of Hydrogeologists and the International Hydrology and Water Resources Symposium of the Institute of Engineers Australia, Adelaide, November 1994](#)
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# Controlled Traffic and Minimal Tillage

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## Best Practice: Controlled traffic and minimal tillage

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Minimal tillage and controlled traffic (at >1.8m) are used together as a part of a whole of system approach. GPS guidance is essential to ensure that all farming operations are done accurately to attain the best benefits of minimal soil disturbance and compaction.

### **Controlled traffic minimal tillage system:**

- Match machinery wheel spacing to the row spacing within the paddock which includes harvester and haul out operations
- Incorporation of GPS guidance into operations can further reduce compaction especially in heavy harvesting machinery and haul outs
- Supports the adoption of minimum tillage including zonal operations
- By incorporating this system compaction of the farmed area can be reduced to 40 per cent with 60 per cent of the bed uncompacted
- Changing from 1.52m to 1.8m+ row spacing will save 1.1km of travel per hectare per operation on farm. If the farming area is 500Ha there will be 550km of travel saved for the spray rig alone when covering the entire farming area

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## Rules of Thumb

- ✓ Use minimum tillage to reduce impact on the soil structure within the paddock and gain improved soil health and root growth
  - ✓ Use controlled traffic in conjunction with GPS. Installing this technology on all equipment including harvester and haul outs will prevent further compaction from heavy machinery
  - ✓ Change to a minimum of 1.8m row spacing to save on travel time during operations
-



### **Effects of compaction on your farm**

- Water infiltration is reduced leading to increased run-off/water reaching the plant roots as a result of compacting the sides of the stool (harvester wheel spacing at 1.8m and driving down 1.5m spaced beds). This reduction causes longer irrigation times to match the crops water requirements
- Decreased area in which the root zone of the plant can be established to take advantage of water and nutrients
- Decrease in soil biota including macro organisms such as worms which will not be able to move within the soil profile due to the compaction within the hill
- Clay soils with heavy compaction become difficult to manage and require excessive heavy tillage operations in order to create sufficient tilth

### **Effects of excess tillage practices on your farm**

- Loss of soil structure impacting on soil health
- Surface sealing/hard facing reduces infiltration leading to increased run-off and limited infiltration
- Increased chance of erosion and sediment loss with increased run-off
- Disturbed soil from excessive cultivation can expose seed banks which cause increased weed growth which leads to excessive herbicide application or cultivation

## **How Minimal Tillage Affects Your Farm's Productivity and Profitability**

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Minimal tillage using controlled traffic (at >1.8m) will create uncompacted permanent beds. Larger wider beds with uncompacted soil provide a better environment for the plant to grow. The root system has a larger area in which it can develop and acquire more nutrients and moisture.

Using minimal tillage combined with GPS, permanent beds can give benefits on your farm including:

- Reduction in irrigations required to grow the crop
- Reduction in the amount of herbicide applications needed to keep the paddock clean until out of hand
- Improved soil health and biota
- Faster and more efficient mechanical operations such as spraying and strategic zonal tillage
- Reduced tillage and a permanent bed system can help for soil available moisture to be retained in the hill. This is particularly important during planting because growers will be able to get on sooner and attain a better plant strike by planting into moisture retained in the hill

### **Green Cane Trash Blanket in Controlled Traffic systems**

Minimal tillage, permanent beds, and controlled traffic can allow some growers on specific soil types to utilize a trash blanket. Trash blankets provide sufficient cover to retain soil moisture and suppress weed growth in the paddock, particularly at early stages in plant and

ratoons where the crop hasn't shaded over. Flood irrigation is difficult when utilising a trash blanket so it is recommended that only specific soil types and blocks with short rows are cut green. Under some circumstances inefficiencies in irrigation due to the trash will negate the positive impacts of the trash blanket. Trash blanketing is commonly practiced when growers are using drip irrigation or overhead in place of flood irrigation.

## Potential Benefits for Your Farm

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If practices are tailored to suit your farming system, controlled traffic and minimal tillage may provide many benefits to your profitability and productivity. Possible benefits may include:

- Less soil compaction with better water infiltration rates and less irrigation applications.
- Higher profitability from reductions in travel time across the entire farming area. 1.1km per hectare less travel per implement saves on machinery and implement fuel and maintenance.
- Improved soil health which leads to more productive crops over time – some growers utilising this system have been able to grow an extra ratoon because the crop performance is still high.

We recommend you [contact one of our extension staff](#). They can help you determine which of these benefits are possible for your farm by modifying your on farm tillage and traffic practices.

Case studies and trials where growers have realised some of these benefits are detailed in the following section.

## Real Results

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Several controlled traffic and minimal tillage methods have been trialled on sugarcane farms in the Burdekin. Studies and economic modelling of the practices and methods showed the following results:

### **Reduced Tillage and Rotational Soybean Crop**

A 60ha cane farm near Ayr used an improved system of reduced tillage operations and a rotational soybean crop that was harvested for seed production. It gained the following benefits:

- Improved farm profitability and sugarcane productivity
- Diversification of farm revenue
- No requirement to change farm machinery and equipment (zero capital costs)
- Reduced chemical and fertiliser quantities and costs
- Labour savings (less time required to cover the same amount of area and faster operations because of the controlled traffic system). **(1)**

### **Controlled Traffic Systems at 1.8m Minimum**

These practices have been implemented on farms in the Burdekin, but no economic analyses are available at this time. [Contact an extension officer](#) for further information about this practice.

### **Wavy Disc Cultivator**

These practices have been implemented on farms in the Burdekin, but no economic analyses are available at this time. [Contact an extension officer](#) for further information about this practice.

### **Furrow Renovator**

This implement has enabled the grower to increase irrigation efficiency. It throws the residual trash onto the hill which results in reduced irrigation time and volume. It has also suppressed weeds and reduced chemical costs. **(2)**

### **Zonal Till Bed Renovator**

Using a zonal till bed renovator has been shown to give benefits of reduced tillage and less soil compaction, green cane trash blanketing (in some regions) and legume crop breaks. An economic analysis also compared zonal tillage to full cultivation and found a saving of \$400 per hectare. **(3)**

## **Water Quality and Environmental Benefits**

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Major water quality and environmental threats from sugarcane farms in the Burdekin are:

- Nutrient and nitrogen fertiliser run-off
- Pesticide run-off
- Sediment run-off. **(7)**

Using the practices can help landholders reduce these impacts and implement the [Reef Water Quality Protection Plan 2013](#). Growers must continue to comply with the [Environmental Protection Act 1994](#) and other Biosecurity Queensland Acts. For further information about meeting the regulations visit the [Reef protection regulations webpage](#).

## **Improving Your Water Quality**

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There are a number of minimal tillage strategies that you can use to improve the quality of water leaving your property. These practices have several environmental benefits, including:

- Controlled traffic farming systems including trash retention reduces the amount of sediment, pesticides and nutrient in runoff. This leads to improved water quality outcomes
- Green cane trash blanketing retains groundcover in the sugarcane system. It reduces erosion potential and suppresses weeds. But, in some circumstances, retaining a

trash blanket may interfere with the efficiencies of water movement throughout paddocks and harvesting. This is particularly important for high yielding and/or flood irrigation districts such as in the Lower Burdekin, where green cane trash blanketing has not been widely adopted due to these potential limitations **(4, 5, & 6)**

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# Legume & Crop Fallows

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## Best Practice: Legume crop rotation - harvested or incorporated back into the soil

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Planting a legume crop during the fallow period as a rotational crop can create additional revenue if grown for harvest as well as improved soil health. Legumes can also be grown as a cover crop to be incorporated back into the soil to bolster soil health.

The legume creates additional organic nitrogen which results in savings from reduced fertiliser rates. Extended fallow periods with a variety of different rotational crops can increase cane production in both plant and subsequent ratoons.

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### Rules of Thumb

- ✓ Use rotational crops to create an additional source of income and improve soil health
- ✓ Lower fertiliser rates in plant cane following a well-managed legume crop
- ✓ Manage organic matter from legume crops by incorporating it back into the soil. Give sufficient time for breakdown of the organic residue before planting cane

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## How Legume & Crop Fallows Affect Your Farm's Productivity and Profitability

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The main areas legume and crop fallows can impact your farm's productivity and profitability are:

- Legumes fix nitrogen in the soil or if sprayed or slashed out the biomass can add additional nitrogen by incorporating it into the soil to break down
- Less applied fertiliser and nutrients will be required in plant cane which decreases growing costs
- Additional revenue on farm if the legume is harvested for grain
- Soil health improvement – increase in soil biota
- Minimal or zero till after a legume crop can help with water infiltration as the root systems of the legume create a sponge like effect on the sides of the hill
- Rotating between a C4 grass crop and a broad leaf allows cheap effective control of

difficult weeds with herbicides registered to broad leaf crops

- Weed pressure/total seed bank should have been reduced in the fallow period allowing minimal herbicide applications in plant and ratoons – increasing the profitability and decreasing input costs
- Extended periods of fallow of 18 months or more have a more profound impact on yields in plant cane and can sustain yield in ratoons. Shorter fallow periods of up to 9 months can have positive impacts on yield/profitability without impacting on crop rotations and planting time

Legume residue needs to be managed correctly by either leaving it on the surface to break down or incorporating it into the soil using a wavy disc coulters. This ensures that plant cane is not planted in anaerobic conditions which will have negative impacts on the strike. The residue above the ground provides nitrogen that was fixed by the crop. This can be achieved by slashing or spraying out the crop. If the legume trash is incorporated into the soil the potential for nitrogen leaching past the root zone of the sugarcane can be increased. Leaching is more likely under wet tropical conditions or poor irrigation practices in drier climates. **(1)**

## Potential Benefits for Your Farm

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If practices are tailored to suit your farming system, well managed legume crops may provide many benefits to your profitability, productivity and soil health. Possible benefits may include:

- Improved yield as a result of increased soil health
- Rotating other crops with cane reduces the risk of income loss by splitting income streams between multiple different commodities that are subject to pricing fluctuations
- Cost savings on fertiliser and nutrients due to fixed nitrogen from legume crop

We recommend you [contact one of our extension staff](#). They can help you determine which of these benefits are possible for your farm by modifying your on farm fallow management.

Case studies and trials where growers have realised some of these benefits are detailed in the following section.

## Real Results

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### Reduced Tillage and Rotational Soybean Crop

A 60ha cane farm near Ayr used an improved system of reduced tillage operations and a rotational soybean crop that was harvested for seed production. It gained the following benefits:

- Improved farm profitability and sugarcane productivity
- Diversification of farm revenue
- No requirement to change farm machinery and equipment (zero capital costs)
- Reduced chemical and fertiliser quantities and costs



- Labour savings (less time required to cover the same amount of area and faster operations because of the controlled traffic system). **(2)**

## Water Quality and Environmental Benefits

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Major water quality and environmental threats from sugarcane farms in the Burdekin are:

- Nutrient and nitrogen fertiliser run-off
- Pesticide run-off
- Sediment run-off. **(3)**

Using the practices can help landholders reduce these impacts and implement the [Reef Water Quality Protection Plan 2013](#). Growers must continue to comply with the [Environmental Protection Act 1994](#) and other Biosecurity Queensland Acts. For further information about meeting the regulations visit the [Reef protection regulations webpage](#).

## Improving Your Water Quality

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Lowering nitrogen rates leaves less inorganic nitrogen available to loss pathways (see nutrients). Maintaining soil health has a positive impact on soil structure and water infiltration which will reduce irrigation times and subsequently reduce runoff.

Pesticide application in plant cane will be reduced due to herbicide applications in the legume crops. Residual herbicide application should not be required in plant cane and as a result less residual herbicides will be available to run off.

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# Pests and Weeds

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## Best Practice: Use an integrated pest and weed management plan

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Managing weeds, pests and disease requires growers to be organised and tactful with their on farm management plans. Most sugarcane diseases cannot be managed by crop protection products by themselves. Diseases can be controlled with a combination of:

- hygiene practices between farms and between farming regions
- variety selection on farm
- Fallow management.
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Effective Weed control includes the following:

- Well timed use of herbicides
- Minimal use of residuals
- strategic tillage to decrease the seed bank
- Farm hygiene when sharing harvesting equipment or implements.
- Rotating herbicides on farm to reduce the instances of resistance.

Due to the effect these practices have on each other, the recommended improved practice is to have an integrated pest and weed management plan that involves all or most of these factors. **(1)**

In this plan, you should use flexible management strategies based on block monitoring, and take into account:

- Pest threshold numbers, populations of beneficial species and levels of crop damage,
- Block history, prevailing environmental conditions, chemical options, rate and timing of applications, and selection of equipment, commonly occurring weed species
- Efficient use of residual and knockdown chemicals (e.g. regular calibration of equipment, nozzle selection, band application, product label recommendations).

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## Rules of Thumb

- ✓ Use calibrated and targeted spraying methods and tools to reduce herbicide loss and pollution
    - For example: banded spraying (dual herbicide sprayer), shielded sprayers.
    - GPS in conjunction with these practices can help with accuracy and ensure that the boom is cut off at the end of the drill so as to not continue spraying out onto the headland.
  - ✓ Use knockdown herbicides where possible instead of residuals. Knockdown chemicals have a shorter half-life to residuals and as a result are less likely to have an environmental impact. They are also a lot cheaper to use and can control weeds effectively if sprayed before the 4 leaf stage
  - ✓ Apply herbicides taking into account rainfall and irrigation timing
  - ✓ Follow label instructions and keep records of amount, time and method of application. Failure to do this could result in fines/audits of your farm
  - ✓ Ensure implements applying Imidichloprid for cane grub management are placing the product in the hill and providing sufficient coverage
  - ✓ Plant multiple varieties of cane to minimise disease risk
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## How Pest and Weed Management Affects Your Farm's Productivity and Profitability

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If practices are tailored to suit your farm's systems, integrated pest and weed management can provide many benefits to your profitability and productivity. Timing of application and correct placement of herbicides and pesticides can have an impact on both product effectiveness and the environment. Possible benefits may include:

- Savings on pesticide and herbicides with more precise application
- Decreased labour and tractor operation costs
- Less pesticides/herbicides lost in runoff
- Increased yields as a result of less competition for nutrients
- Decreased seed bank which will reduce sprays in subsequent cane crops.

## Potential Benefits for Your Farm

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If practices are tailored to suit your farming system, integrated pest and weed management may provide many benefits to your profitability and productivity. Possible benefits may include:

- Savings on pesticide and herbicides with more precise application
- Decreased labour and tractor operation costs
- Reduced environmental impact
- Increased yields from better pest and weed management.

We recommend you [contact one of our extension staff](#). They can help you determine which of these benefits are possible for your farm by modifying your on farm pest and weed management.

Case studies and trials where growers have realised some of these benefits are detailed in the following section.

## Real Results

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Several pest and weed control methods have been trialled on sugarcane farms in the Burdekin. Studies and economic modelling of the practices and methods showed the following results:

### **Progressive Changes in Herbicide Management**

Improvements in herbicide management practices increase farm profitability. This is from higher farm gross margin and annual benefits, and positive rate of return. **(2, 3 & 4)**

### **Shielded Sprayer with Variable Rate Controller**

Growers using this sprayer and rate controller have recognised benefits from no longer needing to plough-out to remove nutgrass, and need less residual herbicide. **(5)**

### **Modified Stool Splitter for Imidichloprid Application**

Stool splitters can be modified with a tank and electric pump to place Confidor® behind the fertiliser in the same pass. This saves time and fuel by combining two implement passes into one. **(6)**

### **Dual Herbicide Sprayer**

The Dual Herbicide Sprayer has shown positive outcomes in both weed kill and overall cost to spray being decreased. The DHS is a cheap alternative to shields and can control problem grasses in sugar cane crops with glyphosate as opposed to expensive residuals. **(7 & 8)**

## Water Quality and Environmental Benefits

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Major water quality and environmental threats from sugarcane farms in the Burdekin are:

- Nutrient and nitrogen fertiliser run-off

- Pesticide run-off
- Sediment run-off. **(15)**

Using the practices can help landholders reduce these impacts and implement the [Reef Water Quality Protection Plan 2013](#). Growers must continue to comply with the [Environmental Protection Act 1994](#) and other Biosecurity Queensland Acts. For further information about meeting the regulations visit the [Reef protection regulations webpage](#).

## Improving Your Water Quality

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There are a number of pest and weed management strategies that you can use to improve the quality of water leaving your property. It is important to be flexible and identify the best options for managing invasive pests and weeds on your farm. These practices have several environmental benefits, including:

- A greater reduction in herbicide losses leaving the farm implies a larger improvement to water quality. Adhering to best management practices for herbicide and pesticide application is the first step in decreasing off farm impacts. **(2 & 3)**
- Correct placement and cover of Imidacloprid in the hill with a stool splitter to decrease the opportunity for it to be lost through runoff via irrigation or rainfall. **(6)**

The amount of pesticide applied to the surface of the soil is relative to the amount of pesticide run off. Banded application reduces the risk of residuals in runoff if they are banded on top of the hill as the water from irrigation events does not reach that height in order to mobilise the actives. Spraying residuals on the hill (if required) and knock downs such as glyphosate in the furrow (DHS or Shields) is an effective method of controlling weeds whilst reducing off farm impacts to the environment. **(10 & 11)**

Knockdown herbicides like glyphosate bind to the soil and there is less runoff than residual herbicides like atrazine, so they are less toxic to the environment **(12 & 13)**. However, each has a different use and should be a part of an integrated pest and weed management plan.

Rainfall events need to be avoided when applying herbicides. There is usually more runoff after rain and this makes the herbicide less effective.

A demonstration farm trail in the Burdekin on 'heavy barratta clay' found that growers had only a small influence on run off during the wet season when irrigation is not used. Management options to improve water quality include banded applications, reducing application and using products with lower residual capacity or non-target toxicity. **(14)**

In simulated rainfall experiments in the Burdekin, band spray application of knockdown herbicides lead to reduced losses in runoff in large rainfall events. This was specifically looking at a plant cane scenario where there is no groundcover of trash or weeds. The pesticides tested were glyphosate, 2,4-D amine and fluroxypyr. All three pesticides were mostly transported in water rather than in sediment and the concentrations of 2,4-D were higher in run off than the other two pesticides tested. **(14)**

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# Sugarcane Extension, Tools & Resources

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## Extension Services

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If you would like to contact the Department of Agriculture and Fisheries (DAF) or an extension officer about the information presented in this factsheet, contact us on:

Phone: 13 25 23 (cost of a local call within Queensland), or +61 7 3404 6999,

Email: [callweb@daf.qld.gov.au](mailto:callweb@daf.qld.gov.au).

Website: <https://www.daf.qld.gov.au/about-us/contact-us>

## Smartcane BMP

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This program assists growers to ensure their practices on farm are at industry standard. It was released in December 2013. It was developed by CANEGROWERS and funded by the Queensland Government.

Website: <https://www.smartcane.com.au/home.aspx>

## Natural Resource Management Groups

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NQ Dry Tropics delivers the Sustainable Agriculture Programme in the Burdekin region, which aims to support and empower producers in the use of best management practices for natural resource management within the agricultural industries.

Website: <http://www.nqdrytropics.com.au/>

## Project Catalyst

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Project Catalyst is a partnership between Reef Catchments NRM, the Coca-Cola Foundation, WWF, NQ Dry Tropics, Terrain Natural Resources, and the Australian Government. It aims to improve water quality and reduce the impact of pollution in the Great Barrier Reef, using innovative land practices. See the website for the most up-to-date contact person.

Website: <http://reefcatchments.com.au/land/project-catalyst/>

## Economic Tools

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### **Farm Economic Analysis Tool (FEAT) for Sugarcane**

Developed by the Department of Agriculture and Fisheries, this excel spreadsheet is designed to assist growers in assessing the profitability in changes to their farm management practices.

Website: <https://www.daf.qld.gov.au/plants/field-crops-and-pastures/sugar/farm-economic-analysis-tool>

Phone: 13 25 23 (DAF)

### **NutriCalc by Sugar Research Australia (SRA)**

NutriCalc™ is an online nutrient management tool and part of the SIX EASY STEPS nutrient management package. Jointly developed with the National Centre for Engineering in Agriculture (NCEA) this tool can help you develop nutrient management plans for use on-farm.

Website: [http://www.sugarresearch.com.au/page/Growing\\_cane/Nutrition/NutriCalc/](http://www.sugarresearch.com.au/page/Growing_cane/Nutrition/NutriCalc/)

### **SafeGauge for Nutrients**

SafeGauge for Nutrients in Sugarcane is a web-based package to assist grower in developing nutrient management strategies to reduce the risk of off-site nutrient movement. It is developed jointly by DEHP and NCEA.

Website: <http://nutrientbudgettool.nceaprd.usg.edu.au/SGlogin.aspx>

## **More Resources**

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### **Department of Agriculture and Fisheries – Sugarcane Information**

Website: <https://www.daf.qld.gov.au/plants/field-crops-and-pastures/sugar>

### **Queensland Agriculture YouTube**

Website: <https://www.youtube.com/user/QldAgriculture>

### **Queensland Government – Farming in Reef Catchments Reef Protection Regulations**

Website: <http://www.qld.gov.au/environment/agriculture/sustainable-farming/reef-initiatives/>

### **Queensland Government – Reef Water Quality Protection Plan**

Website: <http://www.reefplan.qld.gov.au/>

### **Australian Government – The Reef 2050 Plan**

Website: <https://www.environment.gov.au/marine/gbr/long-term-sustainability-plan>

### **Queensland Government Wetland Info**

Website: <http://wetlandinfo.ehp.qld.gov.au/wetlands/management/wetland-management/>

### **Sugar Research Australia – eBooks and Technical Manuals**

Website: [http://www.sugarresearch.com.au/page/Growing\\_cane/Resource\\_library/eBooks/](http://www.sugarresearch.com.au/page/Growing_cane/Resource_library/eBooks/)