Case Study: Bananas

Nurturing the soil and neighbouring wetlands on a banana farm in the Wet Tropics

Gaia Farms is a 95ha property bordered by Cowley and Liverpool creeks, in the Wet Tropics region of Queensland. The Gaia family have owned the former cane property for over 50 years. They decided to start growing bananas 18 years ago and now the property produces mostly Cavendish bananas.

Being in the Wet Tropics region, with an average annual rainfall of over 3m, the farm is subject to wet season flooding as well as tropical cyclones. Both Cyclone Larry in 2006 and Cyclone Yasi in 2011 destroyed the entire banana crop on the property and devastated the banana industry in North Queensland. Despite the challenges faced in rebuilding the farm, after Cyclone Larry they reviewed the farming system and implemented new and improved management practices.

A vision for sustainable, profitable production

The goal has always been to provide a high-quality, nutritious product in a manner that is profitable and minimises impact on the surrounding environment.

With the Great Barrier Reef lagoon less than 10km downstream, Mike and Rene Gaia and their son Brett feel that they have a responsibility to 'adopt clean water practices for the benefit of neighbouring wetlands and the Great Barrier Reef'.

They believe that better soil health is the key to a commercially viable plantation, producing a more nutritious product with less nutrient, sediment and chemical run-off to adjacent wetlands. To learn more about soil health and the sustainability of their farming practices they attended specialised courses, trialled different management approaches and talked to experts.

About the property

- Mike, Rene and Brett Gaia
- 'Gaia Farms' Cowley Creek, south of Innisfail
- Bordered by Cowley and Liverpool creeks
- 95ha property
- 60ha production area, growing Cavendish bananas
- Primarily supply supermarkets
- Aim to have a productive and commercially viable banana farm with minimal impact on the surrounding environment.

Gaia banana farm. Photo: DAFF

Environmental Management Systems help plan management

Environmental Management Systems (EMS) were seen as good models for reviewing existing farm management to identify new practices that would progress their goal for an environmentally and commercially sustainable farm.

Gaia Farms completed a Freshcare Environmental Code of Practice as part of their Freshcare Quality Assurance Program. The Environmental Code of Practice assists growers to document current practice in:

- chemical usage
- fertiliser and soil additives
- water, land and soil management
- biodiversity
- waste, air and energy management.

They also participated in all 3 modules of the Growcom Farm Management System (FMS) and found them to be an effective planning tool to record and formalise farming activities, document practice change and to direct investment into new and improved management practices.

> 'Whilst the market benefits in completing the EMS have yet to be realised, I feel we are now well placed to respond to consumer demand or legislative requirements for environmentally sustainable management practices. The process has been worthwhile for looking at our farm management and providing a framework for improvement.' (Brett Gaia)

Managing horticulture with FMS

The Growcom Farm Management System (FMS) is a risk management framework which addresses 3 areas:

1. soil and nutrient management
2. water use efficiency
3. water quality.

The Growcom FMS is delivered one on one, primarily on-farm and is designed to:

- identify risks posed by farming practices
- provide action planning
- ascertain resources to address the risk
- identify opportunities for improvement to ensure a profitable and sustainable farming business.

It also enables growers to complete components of Quality Assurance programs and assists growers to develop their response to regulatory requirements.

The FMS enables Growcom to benchmark current practices in the horticulture industry, improve delivery of on-going and new projects and better target on-ground activities to assist growers to meet and exceed best management practice.

Managing the banana farm

Around 70% of Australia's bananas are grown along the wet tropical coast of North Queensland. The high rainfall and proximity to the Great Barrier Reef makes it important for agriculture to minimise the loss of nutrients, sediments or chemicals.

Since 2005, new management practices have supported healthy neighbouring waterways while maintaining production and profitability. The potential environmental and production benefits and savings are summarised in Table 1.

Managing soil health is the key

The Gaias are interested in the link between plant health and nutrition for human health and believe that the key to healthy plants and fruit is good soil health.

To learn more about improving soil health, Brett undertook a Certificate of Sustainable Agriculture in 2007 and has since implemented a range of practices to improve soil health such as composting, cutting back on pesticide use and reducing tillage.

Compost production and use was trialled in 2005 and has since been fine tuned to produce a compost ideal for commercial banana production. Compost is applied and provides the following benefits:

- acts as a mulch to reduce erosion and aid infiltration
- improves organic matter content and structure of the soil
- increases soil microbial and biological activity
- improves the soil's ability to hold water and nutrients
- reduces the amount of synthetic fertilisers required (especially nitrogen)
- provides plants with minerals and trace elements.

There has been a definite improvement in soil health, such as increased organic matter and biological activity from 'a combination of compost and other sustainable practices, such as being more responsible with chemical use'. (Brett Gaia)

Compost made and used on the farm. Photo: DAFF

Table 1: Predicted environmental and production benefits from newly implemented management practices

Management	Practices implemented	Environmental benefits	Production benefits and cost savings
Nutrient management: *matching nutrient application to plant needs*	• Soil and leaf analysis (identify nutrient needs) • Fertigation and foliar application (smaller, more regular doses target plant needs)	• Avoid excess nutrient application • Reduce nutrient run-off • Reduce nutrient leaching	• Reduce use of granular fertilisers • Maintain growth and yield • Improve soil health
Soil management: *creating an optimum environment for growth and production*	• Composting (improve soil health) • Reduce the use of chemicals • Reduce soil tillage during planting • Machinery to minimise compaction	• Improve infiltration • Less water and sediment run-off • Reduce chemical run-off • Increase soil biodiversity • Improve soil structure	• Reduce use of granular fertilisers and chemicals (nematicides, fungicides and insecticides) • Maintain growth and yield • Increase soil water holding capacity • Reduce plant stress • Reduce tillage costs
Water management: *matching watering to plant needs*	• Monitor soil moisture (to determine water needs)	• Use less water • Reduce nutrient leaching • Reduce nutrient run-off	• More efficient water use • Reduce pumping costs • Avoid plant stress • Avoid nutrient leaching • Maintain fruit yield and quality
Inter-row vegetation: *retaining topsoil on-farm*	• Slashing rather than spraying inter-rows	• Reduce soil erosion • Reduce herbicide use and run-off • Increase soil biodiversity	• Retain soil on farm • Retain nutrients on farm • Increase infiltration • Reduce herbicide costs • Habitat for beneficial insects (integrated pest management)
Pest and disease management: *controlling pests and disease naturally*	• Improve soil health (combat pests and disease) • Reduce chemical use • Targeted chemical application, i.e. inject rather than spray	• Reduce chemical run-off • Environmentally-friendly pest management • Improve farm biodiversity	• Reduce pesticide use • Improve fruit quality • Improve soil health • Biological control of pests and disease (nematodes, fungus) Encourage predators, microbes, insects, birds
Planning farming activities: *increasing efficiencies throughout the farm*	• Harvest low lying areas before the wet season • Minimise traffic during the wet season • Longer crop cycles	• Reduce soil disturbance during high risk (i.e. boggy) periods • Reduce erosion and sediment run-off	• Ensure access to product for harvest • Reduce risk to machinery and staff • Greater returns with less area of the farm in fallow

Grassed inter-rows minimise erosion. Photo: DAFF

The banana harvester was modified to minimise soil compaction. Photo: DAFF

Cutting chemical use

Bananas grown in the warm, humid conditions of the Wet Tropics are highly susceptible to a range of pests and diseases, notably nematodes and fungal diseases. Brett Gaia found that 'the more we used fungicides the more we had to use them'.

To fight disease they focused on improving soil nutrition and plant health, stopped using nematicides and cut fungicide use to approximately one third of the industry standard. Increased soil organic matter and reduced chemical use provides a suitable soil environment for beneficial microbes and other fauna which control pests and disease.

> 'The 2008–09 wet season was the first time we have reduced disease levels during the wet season. I wouldn't have believed it unless I saw it for myself. It must have been due to soil health.' (Brett Gaia)

Brett Gaia monitoring the bananas. Photo: DAFF

Improved water efficiency and targeted nutrient application

Local Growcom field officer George Russell has assisted the Gaias to improve their water efficiency through the use of soil moisture meters.

> 'Soil moisture monitoring equipment are valuable tools that can help growers make more informed decisions about the frequency of irrigation applications and the length of time these applications occur throughout the production cycle.'

> 'As bananas are a ratooning crop, it is important to supply adequate water to the crop to achieve the best possible growth. Significant production gains can be made through better irrigation management, and soil moisture monitoring is one tool that can help achieve this.' (George Russell)

As the majority of nutrients applied to bananas are taken up in soluble forms it is important to consider irrigation timing and frequency. Supplying the crop with small, frequent amounts of fertiliser can improve crop growth, improve yield and reduce the risk of nutrient loss.

The irrigation system was changed from drippers to under-tree sprinklers and a fertigation system was set up to apply liquid fertiliser in a more controlled and targeted manner. Soil and leaf tests determine the plants' nutrient and trace element requirements, which are then supplied through the fertigation system. This ensures plants receive the nutrients they need while minimising the potential for nutrient leaching or run-off.

The costs of this change in irrigation system are offset by less maintenance, a 20% reduction in irrigation-related expenses and the improvements in soil and plant health.

> 'I only ever used to look up at the leaves to check if the bananas were doing well, I never looked at the soil, now I take more notice of the soil.' (Brett Gaia)

What does it mean for the bottom line?

A cost-benefit economic analysis that compared the original and new management systems assessed the impact of the practice changes on the bottom line of the business.

The analysis indicates that the new management practices are expected to improve the gross margin due to the increased yields and the savings associated with the new farming practices.

Taking into account the capital and annual costs of the new management system, this translates to a gain in **Annualised Net Present Value of $160,000**. The economic costs and savings associated with the new management changes are summarised in Table 2.

It is important to note that the complexity of horticultural production systems means that it can be difficult to isolate the economic value of individual practices.

Table 2: Financial costs and savings of new management practices

Practice implemented	Costs	Savings	Details
Nutrient management:			
Soil and leaf testing: *identify plant nutrient requirements*	• $2500 for soil analysis equipment • $2000/yr in soil and leaf analyses	• Save $1900/ha/yr in granular fertilisers and spreading	• Use 30% less granular fertilisers
Fertigation and under-tree sprayers: *optimise nutrient application to target plant needs*	• $173,000 for new irrigation and fertigation system • $4200/ha/yr in liquid fertilisers		
Soil management:			
Composting: *improved soil and plant health & soil biodiversity*	• $1200/ha/yr in compost and spreading	• Save $3000/ha/yr in pesticides and spraying costs	• Use 60% less fungicide than standard industry practice • Use no nematicides
Reduce tillage and soil compaction: *improve soil health*	• $60,000 each for 3 new harvesters	• Save $660/ha in site preparation costs	• Rotary hoe no longer used, ripper and plough used 60% less
Water management:			
Water monitoring: *optimise water use and efficiency*	• $6000 for two EnviroSCAN	• Save $40/ha/yr in irrigation costs	• One off purchase of capital items
Inter-row vegetation:			
Grassed inter-rows: *reduced soil loss and erosion*	• $15,000 to purchase slasher • $270/ha/yr in slasher labour and maintenance	• Save $200/ha/yr in herbicides	• Herbicide use cut by almost 50%

Explaining Net Present Value

The Annualised Net Present Value (NPV) is a way of determining whether the increase in farm operating profit is sufficient to offset the capital and annual outlays associated with changing to the new management system. A positive NPV implies that the business will be better off from the changes that have been made. Calculating NPV involves discounting future cash flows to Present Value to account for the often large initial capital cost and the smaller but longer term benefit of making a change.

Table 3 shows an example. A discount rate of 8% has been used to convert the future cash flows of the business to their present values (in today's dollar terms). It shows that $100 earned 1 year in the future has a present value of $92.59 (i.e. $92.59 invested today at 8% will grow to $100 in 12 months). The balance of the initial outlay ($300) and the sum of the discounted cash flows over the 5 years ($399.26) is the NPV ($99.26).

Table 3: Example of present value of $100 received in future years.

Discount rate	8%					
Year	0	1	2	3	4	5
Nominal annual net cash flow	-$300.00	$100.00	$100.00	$100.00	$100.00	$100.00
Present value	-$300.00	$92.59	$85.73	$79.38	$73.50	$68.06
NPV	$99.26					
Benefit/cost ratio	-1.33	:1				

What does it mean for wetlands?

Optimising the use of fertilisers and chemicals to respond to plant nutrition and health needs and keeping topsoil on-farm, not only makes economic sense, but is also better for waterways and wetlands.

The new farming practices employed by the Gaias means:

- fewer chemicals (herbicides, fungicides and nematicides) are applied
- nutrients are directed at plant needs, minimising waste and run-off
- good ground cover reduces soil erosion
- the healthier soils are absorbing and retaining nutrients and moisture.

Nutrients, sediments and chemicals are staying on the farm, meaning cleaner water entering adjacent creeks.

Cowley Creek flows through the farm. Photo: DAFF

What's next?

The Gaia's plan to continue trialling new and improved management practices to further enhance the environmental and economic sustainability of the business. The next step is to further optimise nutrient application. Yield mapping technologies and other precision aids holds promise of further reducing synthetic fertiliser use. Through more precise monitoring of plant requirements, fertilisers could be applied at variable rates throughout the property.

Time, money and resources have been invested into the goal of having a commercially viable banana farm with healthy, productive soils and minimal impact on the surrounding environment, and they have come a long way to achieving this.

The fact that the soils are able to support good yields, while inputs of chemicals and granular fertilisers have been substantially cut is testament to the value of soil health in a productive and profitable banana farm.

The changes they have made on the farm are not only good for soil health, but are helping reduce nutrient, sediment and chemical run-off for the health of neighbouring wetlands and the Great Barrier Reef lagoon.

Gaia Farms has been formally recognised for the sustainable management of their production system by winning the Queensland ClimateSmart Rural Award and the Banksia Environmental Foundation Agriculture and Food Award.

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The Queensland Wetlands Program supports projects and activities that result in long-term benefits to the sustainable management, wise use and protection of wetlands in Queensland. The tools developed by the Program help wetlands landholders, managers and decision makers in government and industry. The Program is a joint initiative of the Australian and Queensland governments.

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