Targeted Extension Strategies to Improve Water Quality Outcomes in the Australian Sugarcane Industry - the Herbert case study.

Lawrence Di Bella¹, Dominque O’Brien², Michael Nash³ and Carla Wegscheidl⁴

¹ Herbert Cane Productivity Services Limited (HCPSL), Ingham  
² James Cook University- Tropwater, Townsville  
³ Terrain NRM, Ingham  
⁴ Queensland Government Department of Agriculture, Fisheries and Forestry, Townsville

Contact- ldibella@hcpsl.com.au
Introduction to the Australian Sugarcane Industry

- The sugarcane industry has been operating for over 150 years in Australia.
- The industry produces approximately 30M tons of sugarcane annually.
- Exporting globally 80-85% of what it produces.
- Australia is the third largest exporting sugar nation in the world, following Brazil and Thailand.
Introduction to the Australian Sugarcane Industry

- The Australian industry is within the top 5 lowest cost production countries globally.

- The industry are world leaders in farming, harvesting systems, precision agriculture for sugarcane, sugar transport and loading systems.
Managing Reef water quality

- Sugarcane farming is usually undertaken on the floodplain of the major river systems or their tributaries, which directly drain into the Great Barrier Reef (GBR) lagoon, Australia.

- The Australian Government Reef Water Quality Protection Plan (Reef Plan) states that the majority of the nutrients, sediments and herbicides entering the GBR lagoon are derived from agriculture, primarily sugarcane and grazing. Thus, in recent years the sugarcane industry has been under significant scrutiny associated with agricultural runoff into the GBR lagoon.
Managing Reef water quality

The industry is now the most regulated sugarcane industry in the world for environmental matters (especially concerning nitrogen and pesticide use), because of its close proximity to the Great Barrier Reef.

Location of the Great Barrier Reef

Map data ©2015 Google
Managing Reef water quality

- The Australian government is under pressure from UNESCO & green groups (like WWF) to ensure that the GBR is managed accordingly and protected for future generations.

- Both levels of government are committed to achieving improvements in Reef water quality.

- Reef targets are as follows:
  - A 80% reduction in nitrogen runoff
  - A 50% reduction in sediment
  - A reduction in PS2 herbicides

  (these targets are very ambitious)

- Government is very serious about meeting these targets and has now commissioned studies to investigate options like “Cap and Trade”, N reduction program and change of land use, with other such programs being considered also.

- Will the whole Reef Protection program go away soon? Definitely NOT!

- The next program on the horizon is the management of N20 losses focused on the Greenhouse Gas Emissions program.
The Herbert Water Quality Monitoring Program (HWQMP)

- The HWQMP was established after agricultural industry (especially sugarcane) concerns that there was insufficient water quality data from specific land uses within the Herbert Catchment area.

- The sugarcane industry initiated the project to investigate the relative contribution of land use on the delivery of reef pollutant loads to the receiving waters of the GBR.

- The sugarcane industry engaged the local natural resources management (NRM) group to engage with government, funding agencies and other land users to develop a water quality monitoring program, which in turn would allow the various land user groups to develop targeted extension and industry specific management strategies if issues did arise.
The Herbert Water Quality Monitoring Program

- The project monitored sediment, nutrient and pesticide concentrations in surface waters collected from various sub-catchments and capturing numerous land uses contributing to the Herbert River, end of catchment loads.
The Herbert Water Quality Monitoring Program

- Surface water samples were collected from 17 sites which cover the main land uses within the Herbert Catchment - rainforest, mixed cropping, urban, dairy, mining and grazing in the upper catchment; and sugarcane and urban in the lower catchment.

- The program commenced in July of 2011 and operated for 3 years to monitor water quality for the whole of the Herbert Catchment area.

- The Herbert sugarcane industry and State Government (through EHP) have continued to fund monitoring for the past 2 years post the initial project.
The Herbert Water Quality Monitoring Program monitoring sites.
Linkage projects associated with the sugarcane industry

- At the inception of the HWQMP concept it was proposed to create linkages to other projects or programs focusing on water quality in the sugarcane industry.
- In the sugarcane industry this project was linked to the following projects:
  - The Herbert Demonstration Farm project funded DAFF.
  - The Queensland Government Department of Natural Resources and Mines (DNRM) funded Rainfall Simulation Project and end of catchment monitoring under the Paddock to Reef program.
  - The Australian Government funded the inshore and reef water quality monitoring activities.
  - The DAFF funded Herbert Reef Plan Extension and Education project.
  - The Australian and Queensland Government funded Project NEMO (Nutrient Efficient Management On-farm).
Research findings

Nitrogen levels and some pesticides, including diuron, hexazinone and atrazine, are frequently measured at concentrations exceeding the national guidelines for freshwater ecosystem protection in waters discharging from sugarcane sites in the Herbert sugarcane sub-catchment area (O’Brien et al., 2014).
Pesticides found

- Diuron
- Hexazinone
- 2,4-D
- Desethyl Atrazine
- Desisopropyl Atrazine
- Atrazine
- Total Diuron
- Imidacloprid
- Total Isoxaflutole
- Metolachlor
- Metsulfuron methyl
- Ametryn
- Imidacloprid metabolites
- Triclopyr
- Imazapic
- Propazine-2-hydroxy
- Haloxyfop (acid)
- MCPA
Atrazine

2011-2012

2012-2013

2013-2014

2014-2015

Atrazine (µg/L)
Duiron

2011-2012

2012-2013

2013-2014

2014-2015

Diuron (µg/L)
### Normalised total Photosystem II load (kg)

<table>
<thead>
<tr>
<th>Site name</th>
<th>Total PSII 2009-2010 (kg)</th>
<th>Total PSII 2010-2011 (kg)</th>
<th>Total PSII 2011-2012 (kg)</th>
<th>Total PSII 2012-2013 (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Johnstone River at Tung Oil</td>
<td>9</td>
<td>29</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Tully River at Euramo</td>
<td>181</td>
<td>228</td>
<td>543</td>
<td>970</td>
</tr>
<tr>
<td>Herbert River at Ingham</td>
<td></td>
<td>86</td>
<td>204</td>
<td>1095</td>
</tr>
<tr>
<td>Barratta Creek at Northcote</td>
<td>129</td>
<td>97</td>
<td>148</td>
<td>906</td>
</tr>
<tr>
<td>Burdekin River at Home Hill</td>
<td>115</td>
<td>260</td>
<td>443</td>
<td>1424</td>
</tr>
<tr>
<td>Pioneer River at Dumbleton Head Water</td>
<td>333</td>
<td>301</td>
<td>261</td>
<td>1029</td>
</tr>
<tr>
<td>Sandy Creek at Homebush</td>
<td>181</td>
<td>189</td>
<td>65</td>
<td>83</td>
</tr>
<tr>
<td>Fitzroy River at Rockhampton</td>
<td>1967</td>
<td>1166</td>
<td>1455</td>
<td>2689</td>
</tr>
<tr>
<td>Burnett River at Ben Anderson Barrage Head Water</td>
<td>80</td>
<td>70</td>
<td>66</td>
<td>119</td>
</tr>
</tbody>
</table>
The extension strategy

- As a part of the project an extension strategy was developed whereby the various project stakeholders were provided water quality monitoring results six months prior to the information being made public.
- This time allowed the various project stakeholders the opportunity to be informed of pending issues, develop strategies and implement activities when issues arose.
Response to Duiron issues

The Herbert industry has responded to the Duiron issue by:

- Moving to alternative chemistries
- HCPSL is working with Chemical companies (like DOW, Arysta and Sumitiomo) to find alternative herbicides to replace Duiron
- Promote the use of dual herbicide application equipment
- Work with growers to better manage the timing and placement of herbicides in the farming system.
Sugarcane industry response to Imidacloprid issues

- In response to high levels of Imidaclopid, HCPSL conducted a number of grower shed meetings throughout the district in late August-early September 2012 to inform growers of the impeding risks associated with the improper use of imidacloprid, its impact on water quality and recommendations for effective sugarcane grub control with minimal runoff; over 150 growers attended the meetings.
Sugarcane industry response to Imidacloprid issues

- Since the targeted extension approach in late 2012, associated with product timing and placement there has been considerable reductions in imidacloprid levels detected in water samples in the sugarcane sub-catchments monitored by the HWQMP.

Comparing years for imidacloprid levels found in water quality samples taken as a part of the HWQMP.
Annual average dissolved inorganic nitrogen load (t) 2006-2014

- **Normanby**: 80 t (1%)
- **Barron**: 60 t (1%)
- **Johnstone Sum**: 460 t (7%)
- **Tully**: 450 t (7%)
- **Herbert**: 780 t (13%)
- **Haughton (Barratta Creek)**: 1470 t (24%)
- **Burdekin**: 720 t (5%)
- **O'Connell**: 300 t (30%)
- **Pioneer**: 1500 t (24%)
- **Plane (Sandy Creek)**: 80 t (1%)
- **Fitzroy**: 930 t (15%)
- **Burnett**: 1500 t (24%

Source: Queensland Government, Department of Environment and Heritage Protection.
Sugarcane industry response to nitrogen issues

- In response to the elevated levels of nitrogen in water quality samples collected by the HWQMP and research undertaken by the associated linkage projects.

- The Rainfall Simulation project validated that sub-surface application fertiliser in sugarcane crops had the lowest nitrogen runoff losses when compared to other application methods available to the industry (Cowie et al., 2013).
Sugarcane industry response to nitrogen issues

Since the inception of the Australian Government’s Reef Rescue grants program, HWQMP, and reporting of the Rainfall Simulation trial results, there has been a significant shift from surface fertiliser application to sub-surface application, in the Herbert cane growing region. Surface application of fertilisers reduced from 78% of area treated in 2008 to 38% of area treated in 2013, for the Herbert sugarcane growing region.
The Herbert industry has undertaken the following:

- Changed practice from surface applications to subsurface applications.
- Adoption of Enhanced Efficiency Fertilisers- like Entec™ and AgroMaster ™, with ~30% of Herbert growers assessing or farm scale adoption. HCPSL has been a leader in the research concerning EEFs in the industry.
- Industry adoption of a controlled traffic farming system
- Reducing nitrogen inputs through the adoption of the 6 Easy Steps nutrition (BMP) program to district averages of:
  - 1996- 213kgN/ha
  - 2006- 149 kgN/ha
  - 2016- 145kgN/ha (data supplied by IPL).
Conclusion

The HWQMP has definitely shown that extension programs can have an impact on water quality entering the Great Barrier Reef (GBR) lagoon, if they are well planned, targeted and managed accordingly.
Conclusions specific to the Burdekin

- The Burdekin is not the only sugarcane region that has nitrogen and pesticide issues to deal with- you are not alone.
- Targeted extension programs can lead to positive environmental outcomes, without compromising industry productivity and profitability.
- Seek and invest in local data to base your farm management decisions upon- steer your own ship and take responsibility for the issue at hand.
Conclusions specific to the Burdekin

Don’t bury your head in the sand, because the issue of water quality is not going away!!
Thanks

Special thanks to:

- The Queensland government, SRDC, SRA, QDAF, EHP and local governments for funding the initial project.
- Support by the associated agencies (HCPSL, Terrain NRM, JCU Tropwater, CANEGROWERS Herbert River), Queensland government agencies