Remediation of Agricultural Runoff using High Rate Algal Ponds

A Feasibility Study
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Background

• Project undertaken by BBIFMAC in collaboration with DAF through funding from the Qld Wetlands Program.
• Assessed the feasibility of using freshwater macroalgae in High Rate Algal Ponds (HRAP’s) to treat sugarcane farm runoff in the Burdekin.
• HRAP’s have been used in aquaculture and municipal waste water treatment plants to remove nutrients in effluent.
• This study investigated the potential for HRAP’s to remove Nitrogen and Phosphorus from sugarcane farm irrigation tailwater.
• A local, native freshwater species of macro-algae is proposed.
The HRAP System

- Paddlewheels circulate the algae in the water column.
- For this study a 200m², 50cm deep in-ground HRAP has been modeled.
- HRAP’s can be up-scaled as necessary.

- HRAP’s are shallow, oblong ponds with a raceway shape maximising sunlight exposure of algae.
- Algae take up nutrients and these are removed when the algae is harvested.
HRAP Operation

• When water is exchanged the majority of algae must be removed to remove the nutrients and make room for the algae to continue to grow.
• This is done using a harvesting screen.
• A small quantity of live algae must be retained for re-stocking.
• The algae requires a constant supply of nutrients for survival.
HRAP Performance

• A ‘typical’ Burdekin sugarcane farm’s flood irrigation runoff = 290ML/Year/100ha volume & 679kg nitrogen
• A 200m\(^2\) HRAP would likely treat 36ML/year.
• This is 12% of the 100ha farm’s irrigation runoff.
• Approx. 8 HRAP’s or 1600m\(^2\) of HRAP area would be needed to treat 96% of the farm’s irrigation runoff.
• This would potentially remove 34% of the 100ha farm’s annual nitrogen flux.
• To remove 86% of the farm’s nitrogen flux would require 20, 200m\(^2\) HRAP’s or 4,000m\(^2\) of HRAP area.

*This is 0.4% of the 100ha farm area*
Site Selection

- Several potential scenarios were considered suitable for HRAP installation:

1. HRAP located adjacent to existing farm recycle pit – treated water re-used on farm through irrigation system.
2. HRAP located adjacent to tailwater storage area – treated water discharged into adjacent natural waterway.
3. HRAP located adjacent to existing irrigation channel – treated water discharged into natural waterway.
HRAP located adjacent to existing farm recycle pit – treated water re-used on farm through irrigation system.
HRAP located adjacent to existing farm tailwater storage area – treated water discharged into adjacent natural waterway.
HRAP located adjacent to existing irrigation channel – treated water discharged into natural waterway.
Potential Sites

• Five potential sites for a demonstration trial were investigated as part of the feasibility study.
• The sites provide a good spread of locations around the Burdekin (Airville, Clare, Inkerman, Jarvisfield, Brandon).
• Each site had ready access to a recycle pit or tailwater reservoir for year round water supply.
• Four of the five sites have access to mains power.
• At least two of the property owners were interested in using the algae by-product on their farm and potentially expanding the number of HRAP’s if successful.
Potential Sites cont.
Conclusions

• While HRAP’s have the potential to remove nutrients from sugarcane farm tailwater, the size of the systems required to significantly reduce the nutrient load excludes them from being a practical solution for the average sugarcane farm in the Burdekin (most farms do not have sufficient land area available).

• HRAP’s would need to be used in conjunction with other methods to reduce nutrient loads e.g. best practice farm management.

• HRAP’s would need to be located strategically in order to maximise downstream benefits (e.g. discharge into natural waterways/wetlands rather than recycle pits).

• HRAP’s only have the capability of treating irrigation runoff, however BBIFMAC has found that the majority of nutrient loss actually occurs in rainfall events.