Tropical Water Quality Hub

National Environmental Science Programme



Technology building trust

Image: Boyd Robertson

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The problem

Perceived conflicts between different kinds of land management can be resolved using science – as long as everyone trusts the data. Water quality management in Great Barrier Reef catchments has been a classic example. For decades there has been controversy about changes in farming practice to the point where landholders had begun to lose trust in the science. This situation has been exacerbated by the introduction of Reef protection regulations in 2019 and the recent Senate Inquiry into Reef water quality ("Identification of leading practices in ensuring evidence-based regulation of farm practices that impact water quality outcomes in the Great Barrier Reef"; Commonwealth of Australia, 2020).

One of the biggest challenges in meeting the water quality targets set under the Reef 2050 Plan – and restoring trust - has been the ability to determine with confidence the sources and amounts of dissolved inorganic nitrogen, sediment and other pollutants in river systems that flow onto the Great Barrier Reef. The sheer scale of the area that would need to be monitored, and the expensive nature of the data collection equipment, meant that managers turned to modelling to track progress against targets. The "black box" nature of the models further weakened growers' trust in the results.

The Russell-Mulgrave catchment in the Wet Tropics just south of Cairns was "clearly posing considerable challenges for water quality engagement, and uptake of improved farming practices for water quality" (Davis et al., 2019).

"We are sometimes told that we are the worst polluting catchment and at other times that title goes to [another catchment]… We are told that the information comes from the 'end of catchment' water quality modelling. I can tell you that very few farmers believe that modelling."

Barry Stubbs, second-generation cane grower in the Russell-Mulgrave catchment

The process

If the practices of sugarcane farmers are a major influence on water quality in the catchment, then providing farmers with real-time data about what's happening on their farms will be vital to their decisions to alter those practices. So-called "Project 25" was created as a result of the then Federal Minister for Environment, the Hon. Greg Hunt, meeting with several large-scale sugar producers in the Russell-Mulgrave catchment in late 2015. They collectively identified the need for further water quality research to be undertaken and chose to use a citizen science approach, together with a robust scientific monitoring system. This more localised, adaptive, and targeted system had timely feedback-loops and was designed to strengthen the trust relationship between scientific outcomes and the decision-making related to on-farm practices (James, 2021).

Local canegrowers directly participated and helped steer the research effort and used it to identify hot spot sub-catchment sites. This enabled the growers to be involved in the design and collection of results, and to be part of the solution (James 2021). A stakeholder steering committee was formed even before the project was announced and deliberately included the major industry players, as opposed to the usual willing farmers. These then became advocates and spokespeople for the project. The committee also included state-level CANEGROWERS members, representatives from non-government organisations and scientists to provide policy and technical oversight.

Water quality scientists with established experience and rapport with the sugar industry were involved, as it was acknowledged that the provision of complex messages is best done by trusted, highly credible sources. The project trialled the integration of relatively traditional monitoring approaches (discrete sample collection for subsequent laboratory analysis), with the emerging technology enabling real-time high-frequency (sensor-based) monitoring. The data were available in real-time, though interim embargoes were placed on the data collected. This created a safe learning environment in which committee members could better interpret the data and understand its context.

Explaining the data collection process, the underlying concepts and presenting this local data to the committee as well as to larger meetings, enabled increased Russell-Mulgrave catchment community understanding of the issues. Two-way communication in a coherent, understandable manner proved an effective method of engagement. As noted by Dr Aaron Davis, water quality researcher with JCU's TropWater facility, the presentation of real, locally developed data is clearly a very effective tool for addressing known challenges or points of contention in farmers' understanding of water quality issues.

Another breakthrough was the development and deployment of CSIRO's Digiscapes free mobile phone 1622WQ app, which farmers in the Russell-Mulgrave could use to see the concentration of nitrogen in their local waterways in real time – for example, upstream and downstream of their farms - as well as rainfall. For the first time, farmers had water quality information literally in the palm of their hands, and could relate their own management practices to water quality in local waterways.

Cane grower Barry Stubbs using the 1622WQ app to check water quality around his Russell-Mulgrave cane growing property. Image courtesy of Barry Stubbs


Water level (m)
0.1 mg/N/L
P25

The outcome

Technological advances have allowed accurate and real-time measurements of nitrate concentrations in local waterways throughout the year to be gathered and immediately fed back to local canegrowers via CSIRO's specially-developed mobile phone app. Analyses of wet season data from the study showed that the first big flushes of rain were responsible for a significant proportion of the contaminants that end up flowing onto the Reef from that catchment.

As a result a number of farmers in the Russell-Mulgrave are looking at innovative ways to reduce nitrogen runoff from their properties, including modifying the catchment's existing farm drainage infrastructure, applying fertilisers after cane harvest earlier than before to avoid coinciding with the "first flush" rains of the wet season, and experimenting with lower rate applications later in the year. The addition of gates or baffles to the drainage channel network currently linking sugarcane farms to rivers can slow and filter this first flush of water runoff after the early wet season rains, effectively reducing the amount of damaging nitrates that end up on the Great Barrier Reef.

As for many NESP TWQ projects, while data and technological innovation were key, success has relied upon nurturing trusting relationships between cane growers and researchers.

Another Russell-Mulgrave cane farmer, Stephen Calcagno, who is also the Chair of Cairns CANEGROWERS Association, said "By working together and having real figures and nitrogen data we can rely on and trust, we can now say – both scientists and growers – that besides improving on-farm practices, another part of the solution involves slowing the early rain flush down by using our drains, channels and natural wetlands differently; I see this as the start of really exciting new chapter."

An added bonus of Project 25, with its hi-tech sensors, sophisticated data logging machines, satellite Internet-of-Things connectivity and phone app capability, has been to engage a younger generation of canegrowers. They are already adept at changing their management practices and timeliness of farming decisions based on the real time data being supplied to their mobile phones – be it about weather, cane prices, river heights or water nitrate levels – with Mr Calcagno predicting this new generation of farmers can only lead to even better outcomes for the Great Barrier Reef.

"What growers are really looking for is the data," he said.

"Data is king in the end."

Davis, A. M., Taylor, B., & Fielke, S. (2019). *Engaging with farmers and demonstrating water quality outcomes to create confidence in on-farm decision-making ("Project 25").* Report to the National Environmental Science Program. Reef and Rainforest Research Centre Limited, Cairns (37pp.).

James, J. (2021) *Determinants and principles of establishing greater trust between scientists and farmers*. Report to the National Environmental Science Program. Reef and Rainforest Research Centre Limited, Cairns (54pp.).

In another example of technology building trust, NESP TWQ Hub researchers developed an Internet of Things (IOT) platform that has vastly improved the efficiency of automated irrigation systems on a cane farm in the Burdekin catchment. The platform combines information from weather forecasts and the grower's own watering system to create a suggested model for irrigation for the day, saving the grower huge amounts of time and effort and also minimising wasted water and sediment runoff to the Great Barrier Reef.

"What it's doing is taking the guesswork out of irrigation, which is a big thing for us considering how high electricity prices are. On top of that if you're not putting more water downstream than you have to, you've got less of your nitrogen getting out to the Reef, so there's both an environmental and an economic benefit in it for growers. Personally I'd like to see [this new system] get up across the whole industry."

Aaron Linton, third-generation cane grower, Burdekin region



"The project allows us to monitor the catchment in real-time… we can now see where the problems are and where they are not. We've been working to build sediment traps, a bio-reactor and the construction of wetlands to clean up the water leaving the catchment."

Barry Stubbs, second-generation cane grower in the Russell-Mulgrave catchment

Russell-Mulgrave catchment showing diverse land uses and output to the GBR lagoon. Image: Suzanne Long



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