

Reef Trust Partnership

WATER QUALITY INNOVATION PROGRAM

Impact Report

June 2025

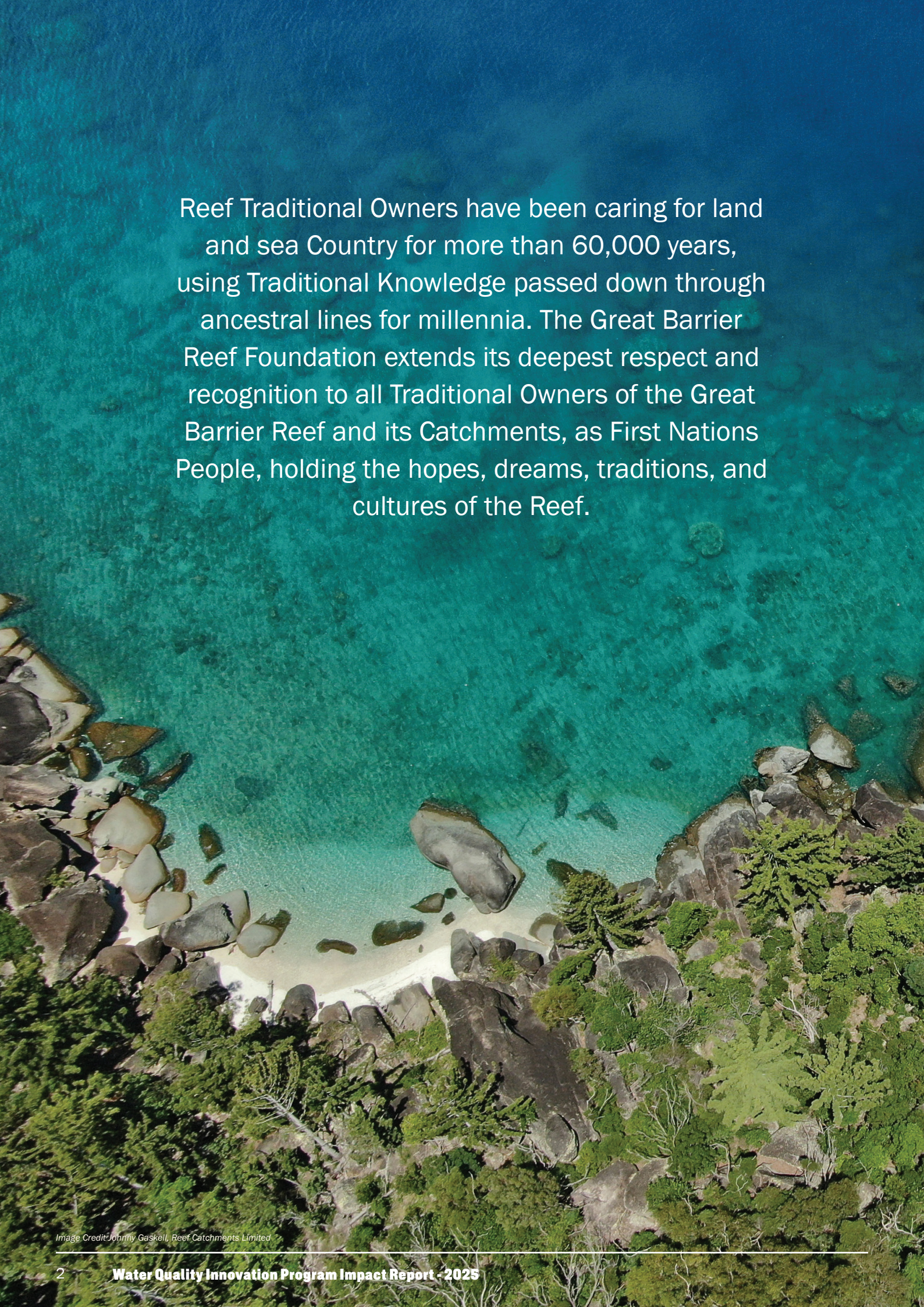


Australian Government

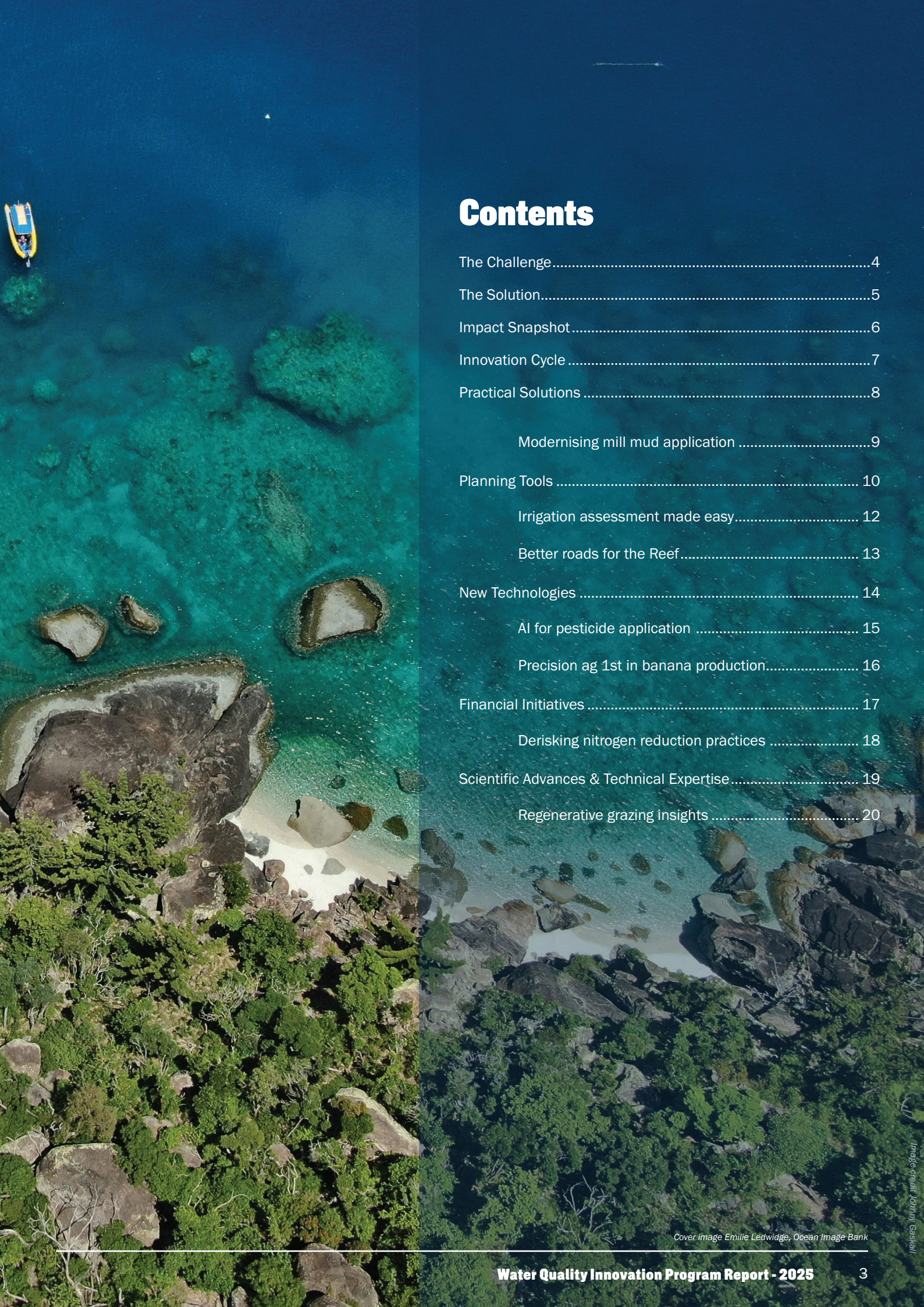
REEF TRUST



Great Barrier
Reef Foundation

An aerial photograph of a tropical coastline. The top half of the image shows deep blue ocean water. Below that is a shallow area with vibrant turquoise water, revealing a sandy beach and numerous large, dark rocks. The bottom half of the image is dominated by a dense, lush green forest covering a rocky shoreline. The text is overlaid on the upper portion of the image.

Reef Traditional Owners have been caring for land and sea Country for more than 60,000 years, using Traditional Knowledge passed down through ancestral lines for millennia. The Great Barrier Reef Foundation extends its deepest respect and recognition to all Traditional Owners of the Great Barrier Reef and its Catchments, as First Nations People, holding the hopes, dreams, traditions, and cultures of the Reef.



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The Challenge

Transformational change is needed to achieve water quality improvement.

The World Heritage-listed Great Barrier Reef (the Reef) is a global icon with an economic, social, and cultural value of \$56 billion to Australia (Deloitte 2017). The largest living structure on the planet, its 3,000 reefs are home to a quarter of all known marine species. The Reef is the Sea Country home for over 70 Traditional Owner groups, and supports Australian livelihoods through the contribution of over 64,000 full-time jobs.

The health and resilience of the Reef are affected by the cumulative impacts of multiple pressures. The ecological changes of the Reef are driven by increased frequency and intensity of weather events and rising air and sea temperatures resulting from climate change.

Sources of land-based pollution include industry, urban and public lands, and agriculture, but most of the water pollution comes from agriculture through sediment, nutrient and pesticide lost through runoff.

Global populations are increasing, and the world food demand is expected to increase by 70 per cent by 2050. Agriculture plays an important role in Great Barrier Reef catchments with over 80% of land area used for food production. Landholders are taking action with a high calibre of work to safeguard the future of the Reef but to reach the ambitious water quality improvement targets, creative ideas and out-of-the-box solutions are needed.

The Solution

Improving water quality plays a significant role in enhancing catchment, coastal and marine ecosystem health, and resilience.

Coral reefs can recover but need our help. Improving water quality buys time for marine and coastal ecosystems to adapt to multiple stressors and increases their ability to withstand and recover from the challenges associated with climate change. Agricultural management practices that increase the profitability, productivity, and sustainability of food production systems can also reduce pollutant loads lost through runoff.

To accelerate water quality improvement outcomes for the Great Barrier Reef, innovative approaches to common challenges are required. Over five years (2020-2025), the Australian Government and the Great Barrier Reef Foundation (the Partnership) invested over \$13 million

into an Innovation Program (the Program) to support the transformational changes needed to achieve improved water quality.

The Program enabled new ways of thinking and doing, fostered partnerships, and enabled collaboration and integration with the Reef Trust Partnership Water Quality Regional Programs. Partners across industry, finance, technology, and scientific fields were enabled to deliver advanced agricultural practices, tools, and approaches that increase productivity and sustainability while achieving environmental outcomes. The range of innovative solutions developed in support of improved Reef water quality outcomes are described in Figure 1.

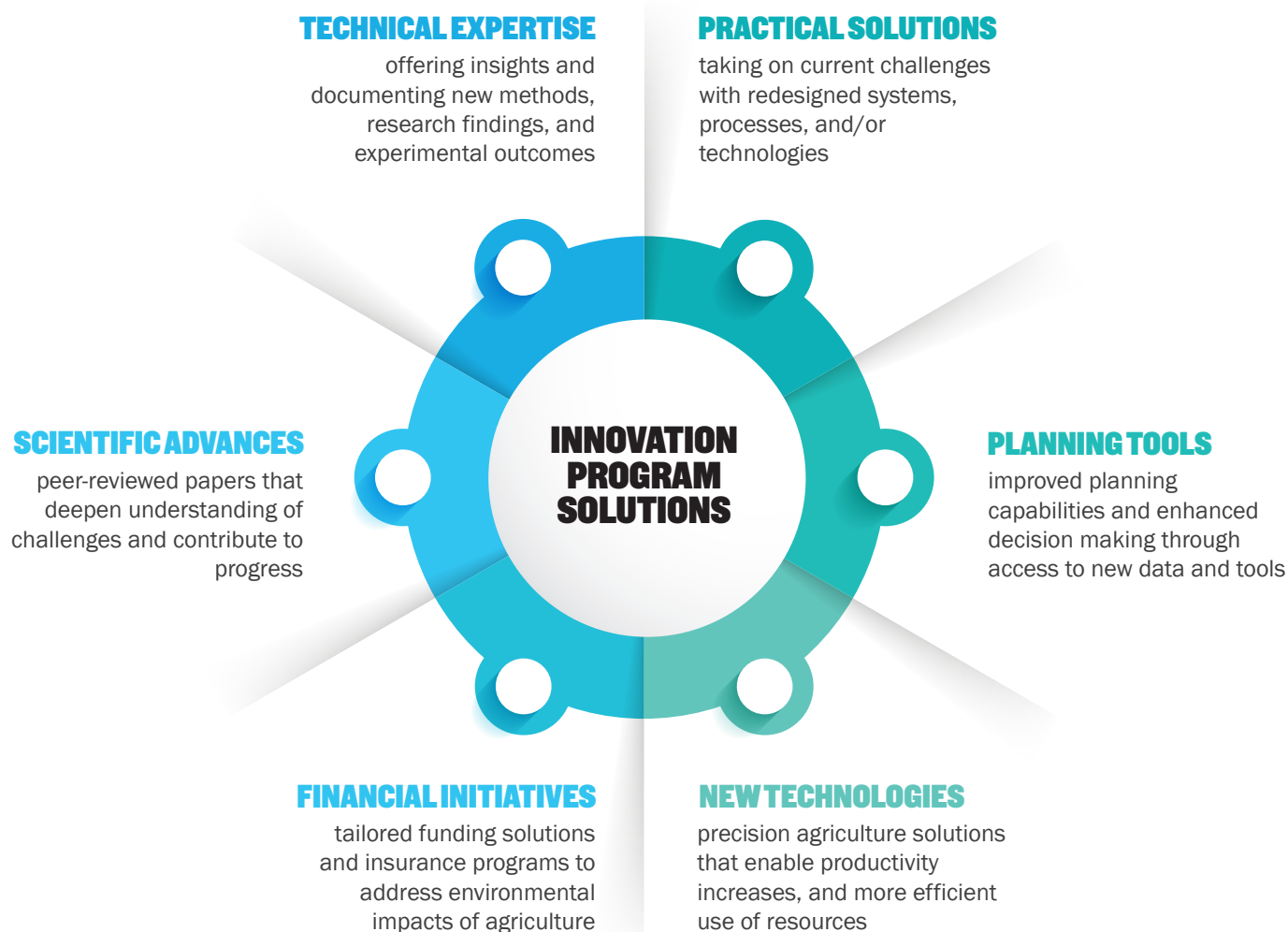


Figure 1. Innovation program solutions

Impact Snapshot

The Reef Trust Partnership successfully delivered 24 diverse innovation projects, each contributing to improved capacity and opportunity for water quality outcomes. Collectively, these projects expanded the suite of solutions available to accelerate and enhance water quality improvements (Figure 2).

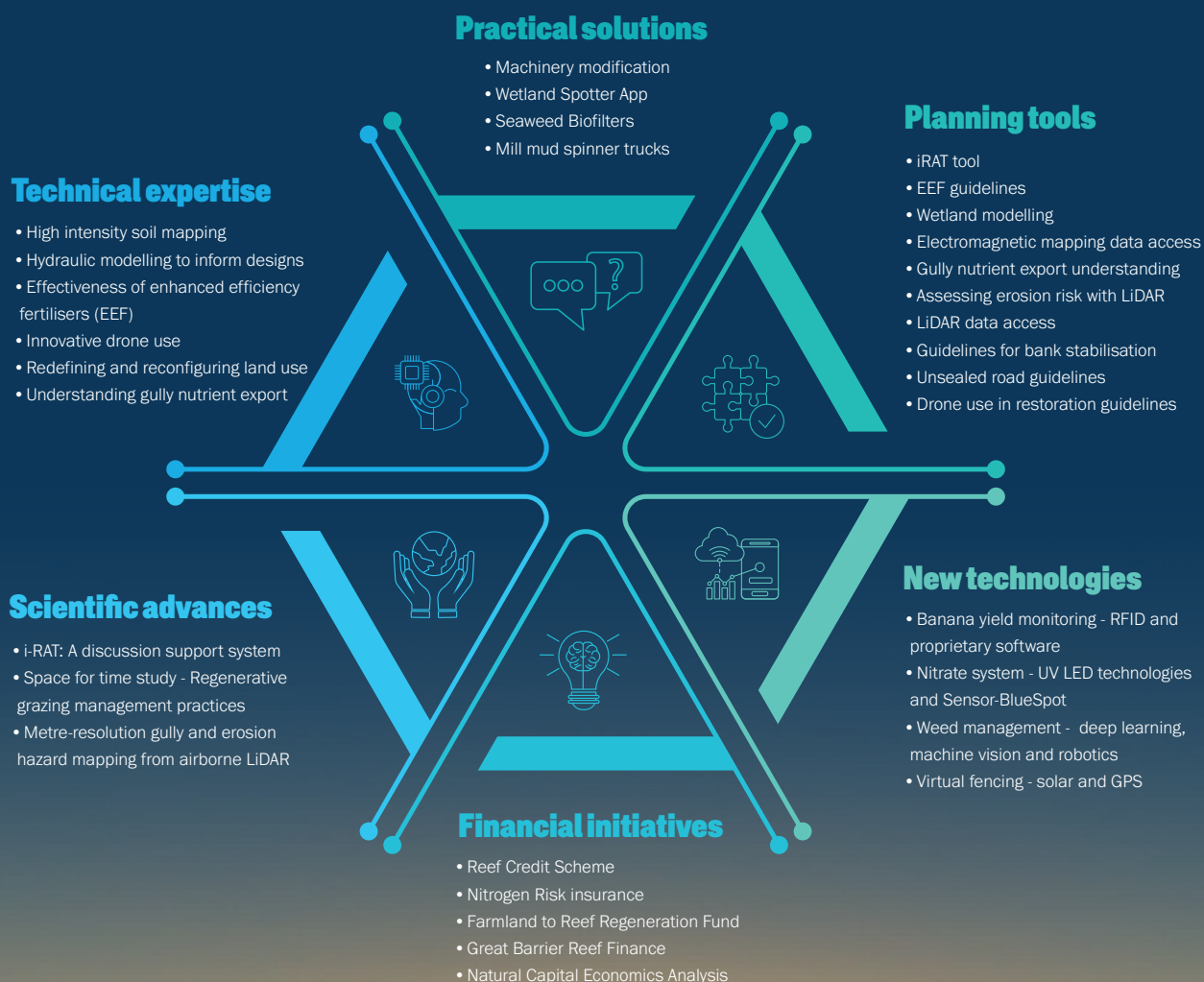


Figure 2. Innovation Program output summary

Innovation Cycle

Projects were funded to progress part or all the way through the innovation cycle which incorporates the generation and proof of concept, feasibility assessment, development, taking the concept to market, and facilitating its broader adoption.



Figure 3. The innovation cycle



Image Credit Sam Thies

Practical Solutions

Taking on current challenges with redesigned systems, processes, and/or technologies.

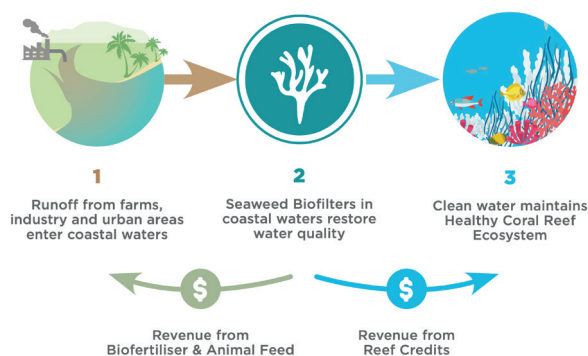


Figure 4. Seaweed biofilter approach. Source ASI

Seaweed Biofilters

A network of native seaweed biofilters between the coast and the Reef were trialed to capture nitrogen and carbon dioxide to help protect the Reef from water pollution and build resilience to climate change. Seaweed is harvested as a bioproduct promoting a circular economy. If deployed at scale, it could have the potential to remove around 3,000 tonnes of dissolved inorganic nutrient per year.



Prototype mill mud spinner trucks

Prototype mill mud spreading spinner trucks were developed to achieve reduced on-farm mill mud application rates; accurate and variable placement on the cane; consistent output for the farmer as required to calculate modified fertilising rates; and wider regional distribution of mill mud. Applying mill mud at lower rates in more targeted inland locations means less nutrient lost to coastal waterways.



Machinery Modification

In the Mackay-Whitsunday region, existing machinery was modified to incorporate multispecies break cropping into over 1600ha of sugarcane monoculture. This cost-effective approach is expected to benefit soil health and improve water quality through better crop uptake of applied nutrients and reduced water run-off.



Wetland Spotter App

The Wetland Spotter ecological and hydrological data capture application enables submission of photographs and other information on wetlands across Queensland to the Queensland Herbarium for identification and mapping. The Wetland Spotter app is available at the iOS App Store and the Android Play Store.



Figure 5. Wetland Spotter App and content. Source DESI

Modernising mill mud application



Prototype mill mud spinner truck with canefarmer Charles Girgenti and Kirsten and Regan Kirnie. Image C/J James, GBRF.

In north Queensland's Herbert region, sugarcane is grown across 65,000 hectares and processed through two mills, Victoria and Macknade. Mill mud is a nutrient-rich by-product of the sugar production process that can be applied to cane fields as organic fertiliser.

Challenge

Every harvest, sugar mills produce mill mud, which is primarily spread over nearby paddocks with freight subsidies. High mill mud application rates can contribute to elevated levels of nutrients in local streams and waterways. In 2021, high distribution costs resulted in 94% of mill mud spread within a 30km radius of the two relatively coastal mills.

Solution

Two prototype mill mud spreading spinner trucks were developed and deployed to reduce on-farm mill mud application rates through accurate and variable placement on the cane across a wider distribution area.

Results

Agro Group's Kristen Kernke said that when using mill mud it is important to understand how nutrient rich the product is in order to use it most efficiently, economically and sustainably.

Mill mud is high in nutrients like nitrogen and phosphorus, which must be considered when fertilising to ensure inorganic fertiliser rate is reduced accordingly.

The current economic climate is driving farmers to think of new ways to reduce costs. Based on agronomic advice, more farmers are applying mill mud and reducing chemical fertiliser rates, which lowers costs and the nutrient losses from the farm.

"Since implementing the new approach, the financial benefits of getting a fourth, fifth or even tenth ratoon out of a cane cycle where they would normally plough out after three viable ratoon cycles.

Farmers are starting to realise that we can't just keep pulling the organic carbon from the soil; we have to start putting it back if we want to keep farming for generations to come," said Kristen.

Kristen said growers are not just using the new technology to save costs on mill mud application.

"Growers want to know, and like the fact, that they are also improving the water quality in our region in the process," said Kristen.

The efficient and user-friendly operating system reduces human error to achieve a consistent output for the farmer as required to calculate modified fertilising rates.

Vince Trovato has been growing cane in the area since 1953. In 2022, he introduced mill mud on his cane for the first time. He says he has never seen a crop like this year's cane and is very happy with the results.

"The mill mud has such good nutrients, so you can cut back on fertiliser," Vince said.

Applying mill mud at lower rates, in more targeted inland locations means there is less nutrient runoff into coastal waterways. The product is delivered where it is really needed, and more remote farms are now accessing mill mud where it may not have been economical in the past. This benefits the entire sugar farming community.

Outcomes

There has been a 15% increase in mill mud application more than 30 kilometres from the mill. Broader and more precise application of mill mud is benefiting individual farms while making a significant contribution to the health of the lower Herbert waterways.



Precision application of mill mud. Image Agro Group.

Planning Tools

Improved planning capabilities and enhanced decision making through access to new data and tools.

IRAT Tool

The irrigation rapid assessment tool ([i-RAT](#)) discussion support system and visualisation tool is used to rapidly assess the impacts of different sugarcane irrigation practices to bridge the gap between better irrigation management and natural capital accounting. Farmers are encouraged to transition to more efficient irrigation practices that will deliver a better economic and environmental outcome.



EEF guidelines

Field trials and modelling of the [effectiveness of enhanced efficiency fertilisers](#) (EEF's) in the Wet Tropics found that when nitrogen (N) is applied at rates lower than industry recommendation (6ES), EEF's can maintain productivity and profitability and reduce N loss when compared to standard urea applied at the 6ES recommend N rate.



EMI mapping data access

Soil attribute maps using electromagnetic induction (EMI) technology in combination with conventional soil survey data were created for 2,025 hectares in the Russell River catchment. This data is used to identify and inform management of soil and crop productivity zones for best practice nutrient application. Information is publicly available through [Queensland Globe](#) and Qspatial.



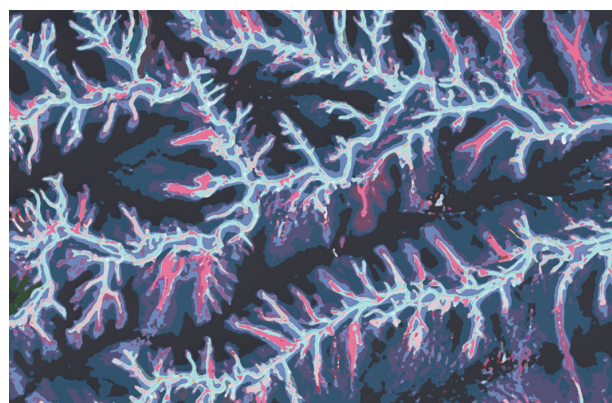
Historical erosion data access

An unprecedented 130,000km² repeat LiDAR dataset was reprocessed into a 0.5m repeat DEM (digital elevation model) of Difference dataset across GBR catchments. This data is used to determine the sediment abatement potential of a proposed site for the prioritisation of cost-effective landscape rehabilitation. The dataset is publicly available on the [ELVIS portal](#).



Assessing erosion risk with LiDAR

Gully and stream channel extent were mapped across the full range of publicly available high-resolution Reef Trust LiDAR and is publicly available via the [CSIRO data access portal](#). The mapping systematically identifies incised erosion features based on the presence of convex curvature around the edge, steep sides and relatively flat bottoms enabling preliminary estimation of individual gully volumes for erosion control.



Bright blue denotes areas at the highest risk of gully erosion. Red denotes areas which have both high risk of gully erosion and poor woody vegetation cover, which are of highest priority for managing and protecting from gully erosion, CSIRO.

Planning Tools



Understanding gully nutrient export

Large scale gully remediation projects that reduce significant amounts of sediment run-off were investigated for potential nutrient pollution reduction. A [report](#) provides a better understanding of the role of different soil amendments used as part of gully remediation on the export of bioavailable nitrogen (BAN) and other bioavailable nutrients (e.g., carbon and phosphorus).



Guidelines for bank stabilisation

A revised shear stress reduction approach was investigated. Shear stress reductions can be estimated without undertaking detailed modelling of design scenarios which helps reduce design costs for low-risk projects. [Guidelines](#) allow designers to understand the potential impacts of pile field groynes on river hydraulics and sediment transport processes.



Drone BMP guidelines

In-situ trials were conducted comparing drone and manual restoration applications for monitoring, weed treatment, and revegetation across three sites in the Great Barrier Reef catchment. As a result, [Best Management Practice guidelines](#) were developed for drone use in riparian and wetland restoration.



Drones were used for vegetation and germination assessments, monitoring, weed treatment, and seeding at the riparian and low-lying wetland trial site, Greening Australia.

Unsealed road BMP guidelines

Over 42,000 kilometres of combined State and Local Government unsealed roads were mapped and evaluated. Four study sites provided unsealed road to stream mapping. A modelling framework to support the identification of high-risk unsealed road segments was developed. Baseline data and methodologies informed [Best Management Practice guidelines](#) for cleaner road runoff.



Wetland model development

A new and innovative model and platform specifically configured for the characteristics of hydrology, ecology and water quality that are found in wetlands within the Great Barrier Reef catchments was developed to demonstrate, with increased confidence, the role of wetlands in water quality improvement, and support the basis for future prioritisation and investment.



Irrigation assessment made easy

The Burdekin is Australia's largest sugarcane producing region and is reliant on irrigation. Efficient irrigation improves profitability and sustainability. Inefficient irrigation practices result in runoff of pesticides and nutrients impacting water quality and the farm's bottom line.

Challenge

Complex interactions between soils, climate, and farm management require a tool to show which management practice changes are more likely to deliver improved water quality and climate resilience outcomes while maintaining profitability.

Solution

James Cook University (JCU) and partner Agritech Solutions developed a 'discussion' support system Irrigation Rapid Assessment Tool (i-RAT) drawing on concepts from social studies of science and technology.

Results

i-RAT allows farmers to compare different irrigation scenarios promoting the adoption of scientifically defensible, practical, and superior irrigation solutions. The rapid assessment-visualisation tool is in an interactive web application that compares the impacts regarding farm economics, water quality, productivity, carbon and nitrogen cycles, and greenhouse gas emission.

Dr Brian Collins, Senior Research Fellow at JCU's Agriculture Technology and Adoption Centre, said the i-RAT is designed for cane growers to explore the impact of changes in irrigation management on their paddocks' productivity and profitability.

i-RAT was developed to make it easier for the industry to see how small, medium, and large changes in irrigation management can increase profit, save water, and reduce energy costs.

"i-RAT harnesses the power of computer modelling and combines it with the knowledge and experience of local cane growers and advisors to enable rapid comparisons of thousands of combinations of farm management scenarios, which are not possible to test in the field," said Dr Collins.

Outcomes of improved irrigation practices include increased profitability and productivity, and reduced runoff for better water quality.

Outcomes

Use i-RAT by creating an account on <https://i-rat.net> using an email address.



Image Mackay CANEGROWERS

Better roads for the Reef

Erosion and sediment runoff from land uses in Reef catchments reduces water clarity, slows coral growth, and smothers sea grass meadows and inshore coral reefs. In regional and remote areas, many roads are and will remain unsealed as they do not attract the volume of traffic to justify sealing.

Challenge

There is a perception that the running surface and roadside drainage of unsealed roads export high volumes of fine sediment to the Reef despite little investigation or reporting into the actual impacts of this land use.

Solution

Investigate and measure the sediment loads in five diverse local government areas and extrapolate this data through modelling across Reef catchments to determine the actual impact of unsealed roads on sediment discharge.

Results

This Local Government Association of Queensland (LGAQ) experimental project, was supported by an expert field team and overseen by a Technical Advisory Committee.

Staff from the Gladstone, Cassowary Coast, Whitsunday, Isaac, and Bundaberg local governments participated in the installation of monitoring equipment and collection of field samples.

The monitoring data varied significantly across the five study sites with various geographical and rainfall characteristics. In all cases sediment export from unsealed roads was between 3-14 times higher than for surrounding land uses such as grazing and agriculture. The footprint of the road network is much less than other land uses, and the overall export is not as significant as perceived but does vary between sub-catchments.

Via a partnership between the Foundation and consultancy firm AECOM, the monitoring results were extrapolated through modelling to predict sediment runoff from all unsealed roads across the entire Reef catchment.

The LGAQ collaborated with the Foundation funded South Cape York Catchments Road project in the Cook Shire using increased scientific understanding of sediment erosion from unsealed roads and their associated drainage systems to develop a series of Best Management Practice (BMP) guidelines.

Outcomes

AECOM has modelled fine sediment export for all 47 sub-catchments within the State Government's Paddock to Reef modelling program and hotspots can be identified for the prioritisation of road maintenance and drainage management. [BMP Guidelines](#) for unsealed road maintenance and drainage management were published and distributed to local, State and Federal governments.



LGAQ project team's Bill Johnson and Gladstone Regional Council team member Nasurat with pass sampler. Image CCRC.



LGAQ project team's Megan Forrest and Gladstone Regional Council team member Brett at Gladstone study site. Image CCRC.

New Technologies

Solutions that increase efficiency, enable productivity increases, and more sustainable use of resources.

Banana industry-first yield mapping

An industry-first approach to nutrient management was developed bringing together a range of technologies and purpose-built software to acquire and process data for a precision agriculture approach to banana production systems. Bagging reports, bunch weight reports and yield maps have been produced in trials and integrated with soil mapping and soil test data to inform a precision approach to nutrient management.



Prescription map developed using the new yield mapping technology and proprietary software, Farmacist.

Virtual fencing

A new agricultural technology was used to establish virtual fences in challenging terrain that are typically unsuitable for traditional fencing. Trials were undertaken to validate the ability of the system to protect sensitive catchments and waterways from damage caused by cattle. Trial **outcomes** informed hardware changes for increased robustness and post-project trials are underway in the Burdekin.



Automated weed management

Using the **latest advances** in deep learning, machine vision and robotics, the cutting-edge system uses smart detection to spot spray weed species in a crop or pasture environment. The mobile smart-robot that identifies a weed in real time and releases just enough pesticide to manage the infestation has proven to be highly effective at eliminating weeds and reducing pesticide use.



Low-cost DIN sensor

A low-cost **Nitrate Sensor system** using UV LED technologies and Sensor-BlueSpot system for research, scientific, and commercial purposes was developed and a limited field trial of a prototype successfully conducted. A business case identified that key market segments need to create a demand for the low-cost Nitrate Sensor /Telemetry Systems.



DIN sensor prototype installation for a limited tank trial at the Hydrographic Support Unit at Rocklea, IntelliDesign.

AI for pesticide application

The Australian agricultural sector is one of the largest users of herbicides in the world. Although the risk posed by herbicide and pesticide usage has dropped significantly in recent decades, traces have been detected in Reef ecosystems at concentrations high enough to affect some plants and animals.

Challenge

Traditional weed-control techniques typically include blanket spraying across vast areas, which causes large volumes of pesticides to enter the Reef environment.

Solution

Townsville-based tech firm AutoWeed partnered with James Cook University to design a smart system that uses deep learning and machine vision techniques to detect and spray weeds without hitting sugarcane.

“

Seeing sugarcane farmers genuinely amazed at our system's ability to automatically detect weeds and apply herbicide is a real treat. This tool is a win-win for sugarcane farmers and the Reef.¹ ”

Results

AutoWeed is a mobile smart-robot that can identify a weed in real time and release just enough pesticide to manage the infestation. It has proven to be highly effective at eliminating weeds and reducing pesticide use.

Autoweed has collected over five million images of weed species across the three main sugarcane growing regions in the Reef catchment areas and have developed deep learning models for accurate detection of weeds, delivering average weed knockdown efficacy of 96%.

“We’re happy to be able to contribute our artificial intelligence solutions and see them having a positive impact on the Reef,” said AutoWeed co-founder Alex Olsen.

The deep learning technology makes AutoWeed’s system flexible and capable of collecting important information about crop growth and yield, as well as detecting insects and other pests for early intervention.

Lead project researcher Associate Professor Mostafa Rahimi Azghadi said the testing of the innovative green-

on-green spot spraying technology completed across 86 hectares has shown that on average robotic spot spraying on sugarcane farms is 96% as effective at weed knockdown compared to the industry practice of blanket spraying.

“In the best case where weed infestation has been lower, we have saved up to 89% in herbicide usage. This equated to cost savings of \$1,385 for the entire 23.4-hectare paddock.”

“This is a win for the environment and a win for growers,” he said.

A water quality assessment produced by Sugar Research Australia during testing also found that paddocks which used the AutoWeed AI sprayer reduced their chemical concentration in water run-off by an average of 46% compared to blanket spraying.

AutoWeed achieved significant technical outcomes including the design, development, and deployment of three different spraying systems with versatility for deployment on a variety of weeds and farms in reef catchment areas across Queensland.

Outcomes

AutoWeed worked with [the Growth Drivers](#) to understand its commercial feasibility and continues to refine and field test prototypes.



AutoWeed system in action on farm, AutoWeed.

Image credit: Jill Conica

¹Alex Olsen AutoWeed Co-Founder

Precision ag 1st in banana production



The Abbot family, (Ben Abbott on right). Image Farmacist.

Nutrient losses from farming are one of the biggest contributors to poor water quality on the Reef, which threatens corals and other marine life. Precision agriculture helps industry improve productivity, profitability, and reduce its environmental footprint.

Over 90% of Australia's bananas are produced in Reef catchments (ABGC). Banana growing and horticulture contribute 1% of total exports of dissolved inorganic nitrogen, and large amounts of pesticides to the Great Barrier Reef (C20, 2022).

Challenge

Yield variability maps have supported efficient and sustainable farming practices but applying these tools in the banana industry is uniquely challenging.

Sugarcane and cropping industries can map yields while harvesting an entire paddock. A large banana paddock requires harvesting by hand every week.

"Grain harvesters have two or three headers harvesting thousands of hectares, it's all grown at the same time. With bananas, some of the bunches will be ripe this week, some next week, and some the week after," said Will Higham, Farmacist's Far North Queensland Project Lead.

Solution

Precision agronomy solutions company Farmacist have produced a Banana Yield Monitoring system, a technology solution to develop the yield maps required for precision application of fertiliser through variable rate application.

Results

RFID tags with a unique ID number are deployed onto bagged banana bunches in the field. An interactive grower portal provides real-time tracking of each banana bunch from field to packing shed. On harvest weights are recorded in the packing shed and an RFID tag reader generates a report. Proprietary software provides data through a grower interface to map yield, plan nutrient application, manage the workforce, and plan harvesting.

The first prototype was deployed in Lakeland in 2018 on Red Valley Farm where the Inderbitzen family provided feedback and contributed to the design and testing process.

In Far North Queensland, Ben and Matt Abbott tested prototypes on their Mena Creek and Wangan farms collecting data about banana growth rates to identify where they need fertilisers most – and where they do not.

"I see this technology could transform the way we farm. I believe it will be a tool to not only improve our productivity and efficiency, but it will allow us to continually improve and refine our farming practice through the data it collects," said Ben Abbott.

The latest version, prototype four, is more streamlined and efficient, and features advanced functionalities that extend beyond basic yield tracking. A key enhancement is the real-time data viewing capability through a grower interface, enabling immediate data upload and analysis.

This upgraded system empowers farmers to make instant, informed decisions based on real-time data. "The system has come a long way. It's more than just tracking yield variability now; it's a game-changer for optimising labour efficiency," said Peter Inderbitzin Jr.

Outcomes

The Banana Yield Mapping system is anticipated to be commercially available to banana growers in Queensland by 2026.

Financial Initiatives

Tailored financial solutions to address the environmental impacts of agriculture.



Herbert field visit linking soil health to productivity. HCPSL.

Farmland to Reef Regeneration Fund

A [feasibility study](#) into a long-term, landscape scale, impact investment fund to deliver positive environmental and biodiversity outcomes for the Great Barrier Reef and its catchments was completed. In three phases, potential sectors and geographies were scoped; an investment model and related financial and environmental modelling was developed; and the legal structure and governance arrangements were established to launch the **Great Barrier Reef Natural Capital Fund**.



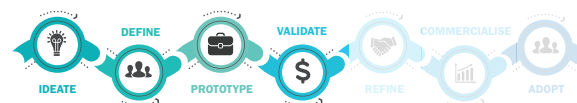
Reef Credit Scheme

Reef Credits are a market-based solution offering landholders a new way to improve the quality of water entering the Great Barrier Reef. Eco-Markets Australia are the first independent administrator of environmental markets in Australia and are trading through the [Reef Credits website](#). Current methodologies include dissolved inorganic nitrogen, grazing land management, gullies and wetlands, and wastewater (in review).



Redefining and reconfiguring land

Financial performance of sugarcane farms and relationships between various farm and farmer characteristics (e.g. farm profitability and farmer age), and where they may be relevant to land use transitions (i.e., to buy or sell land) were analysed. As a result, complementary [policy mechanisms](#) for facilitating land use transitions were identified, along with their potential impact on a range of different indicators (e.g. water quality, profitability).



Great Barrier Reefinance

The Great Barrier Reefinance used community champions to uncover opportunities for farm ownership transition with improved environmental outcomes. The [Cultivate Farms](#) model of transitional farm ownership has been used 29 times in Australia in recent times. This equates to 25 landholders using the model to transition custodianship of the land to another farmer.



Nitrogen risk insurance

Nitrogen Risk Insurance is an innovative economic lever developed to manage the risk of reduced sugarcane yields from lower application of nitrogen fertiliser. Insurance protects farmer income and [can be purchased](#) for part (blocks) or whole of farm. This world's first commercial product has been tested (prototype and real insurance policies) in the Wet Tropics, the Herbert, and Mackay-Whitsunday regions.



Derisking nitrogen reduction practices

The production of sugarcane in Australia relies on the application of large amounts of nitrogen fertiliser. Farmers cannot accurately predict the amount of nitrogen a crop will need in a given growing season because variable weather makes it difficult to match nitrogen supply exactly to crop demand.

As a result, farmers are cautious when applying nitrogen fertiliser, aiming to safeguard yields by ensuring the crop will have adequate nitrogen in all years. This can lead to seasons where more fertiliser than needed is supplied. In these situations, the over-application of fertiliser can lead to the loss of excess nitrogen off-farm which poses a major threat to coastal ecosystems and the Great Barrier Reef (GBR).

Challenge

The risk of productivity shortfall is a primary motivation for sugarcane farmers when determining nitrogen rates. Even with regulatory incentives and the pressure of high fertiliser prices, concerns about under-fertilisation and possible yield shortfall leads many farmers to maintain a cautious approach to nitrogen rates and improved practice adoption.

Solution

Developed by CSIRO and partners, Nitrogen Risk Insurance is an innovative solution to this ongoing challenge which de-risks lower nitrogen fertiliser use by guaranteeing compensation for any financial losses in seasons where reduced nitrogen applications lead to a productivity decrease.

Results

Queensland sugarcane farmers are currently using Nitrogen Risk Insurance to cover the risk of yield shortfall from reduced nitrogen application. The insurance protects farmer income and can be purchased for the entire farm or by block providing flexibility to suit the individual production system.

The Nitrogen Risk Insurance is underpinned by over 25 years of CSIRO's soil, agronomy, and climate data analysis. Crop models determine yield by linking soil, time of ratooning, weather conditions, crop growth and nitrogen requirements, creating a scientifically grounded measure of the likelihood and extent of yield shortfalls from reduced nitrogen application.

The claims process is automated, with payments triggered by crop modelling results based on actual rainfall, temperature, and solar radiation measurements from the Bureau of Meteorology during the crop growing season for the insured location. There is no need for insured farms to lodge a claim for this automatic assessment.

This world-first commercial Nitrogen Risk Insurance product has been tested in the Wet Tropics, the Herbert, and Mackay-Whitsunday regions. Twenty-two Nitrogen Risk Insurance policies covering 250 hectares were sold between 2022 and 2024 during the commercialisation process. The average reduction rate for nitrogen was 17 kilograms per hectare.

After factoring in cost of the insurance, cost of fertiliser, and insurance payouts, where applicable, the average cash benefit to farmers was \$30 per hectare (excluding active 2024 policy data). Extrapolation of this data shows that substantially increasing the insured crop area can lead to considerable cash benefits for farmers and dissolved inorganic nitrogen reduction benefiting the GBR and community.

The Nitrogen Risk Insurance program has demonstrated significant water quality and economic benefits (to both farmers and the public) and is on track to become self-sustaining.

Next Steps

The focus is now on raising awareness of the Nitrogen Risk Insurance to extend the benefits through broader adoption.



Image Jeff Grench, Catchment Solutions



Scientific Advances & Technical Expertise

Published works offer insights and document new methods, research findings, and experimental outcomes that deepen understanding of challenges and contribute to progress.

Alluvium (2022) Hydraulic modelling of pile filed groyne bank stabilisation to inform design guidelines. [Report P420065_R01](#) by Alluvium Consulting Australia for the Great Barrier Reef Foundation

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Connellan, J., Thompson, M., Webster, T., Salter, B., Olayemi, M., Verburg, K., Biggs, J., Thorburn, P. (2023) On-ground testing and modelling of the effectiveness of enhanced efficiency fertilisers in the Wet Tropics catchments of the Great Barrier Reef. [Final report 2020/803](#). Sugar Research Australia, Queensland

Garzon-Garcia, A., Newham, M., Bloesch, P., Catton, K., Stout, J., Pietsch, T., Reeves, S., Spencer, J., Brooks, A. (2022). Understanding nutrient export from remediated gully systems. Brisbane: Department of Environment and Science, Queensland Government [DES Report 2022](#)

Greening Australia (2023). Innovative drone use in riparian and wetland restoration: Best Practice guidelines. [BMP Drone usage for restoration](#)

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Regenerative grazing insights

Regenerative grazing, which usually involves rotational grazing with strategic rest, is increasingly seen as a profitable management approach that can accelerate landscape recovery. This study demonstrated that improvements in vegetation, soil and land condition can be obtained by implementing regenerative grazing principles in semi-arid rangeland areas of Northern Australia, however, it is likely to take a minimum of 3–5 years and up to 15–20 years for statistically significant improvements to be measurable at a site.

What is regenerative grazing?

Regenerative agriculture seeks to profitably produce food in a way that is kind to the environment. There are numerous terms used to describe the components of regenerative grazing, including holistic, rotational or timed rest systems. The emphasis is on providing strategic rest to pastures and soils and protecting the natural capital of the grazing enterprise (i.e. soil, vegetation, and water assets).

What did this project do?

This 2-year space for time study collected vegetation and soil data from a range of properties in the Burdekin catchment that have implemented regenerative grazing strategies for between 5 and 20 years. Data were collected from several sites where grazing had been excluded for about 30 years. Coincident data were also collected at adjacent control sites that did not undergo regenerative grazing, but where more traditional, continuous setstocking grazing approaches had been applied.

What did we find?

Results suggest that improvements in vegetation, soil and thus land condition, can be obtained by implementing regenerative grazing principles. Although, it is likely to take at least 3–5 years, and up to 15–20 years for statistically significant improvements to be measurable at a site, particularly for areas that are moving from a very degraded baseline condition. The key message is to avoid degradation where possible, as it can take a long time to recover land condition.

Vegetation attributes such as biomass, plant basal area, and litter incorporation all appeared to be better surrogates for quantifying improved land condition and soil health than percentage ground cover.

Sites that maintained remotely sensed percentage ground cover at or above the minimally disturbed reference benchmark levels for >10 years, as well as having statistically higher biomass, basal area and litter, had significant increases in total nitrogen and soil organic carbon relative to the local control site. Proportional increases in soil organic carbon can be higher or as high at long-term regenerative grazing sites (relative to an un-treated control) compared to sites that have had no grazing for c. 30 years.

What does this mean for graziers?

Implementing regenerative grazing strategies will likely improve soil and vegetation condition in the long term. However, careful thought needs to be given to the grazing system applied, which will vary with the size and structure of the grazing business.

Collecting and recording pasture and soil data in the paddock at regular (c. 5 year) intervals will be important for monitoring improvements over time.

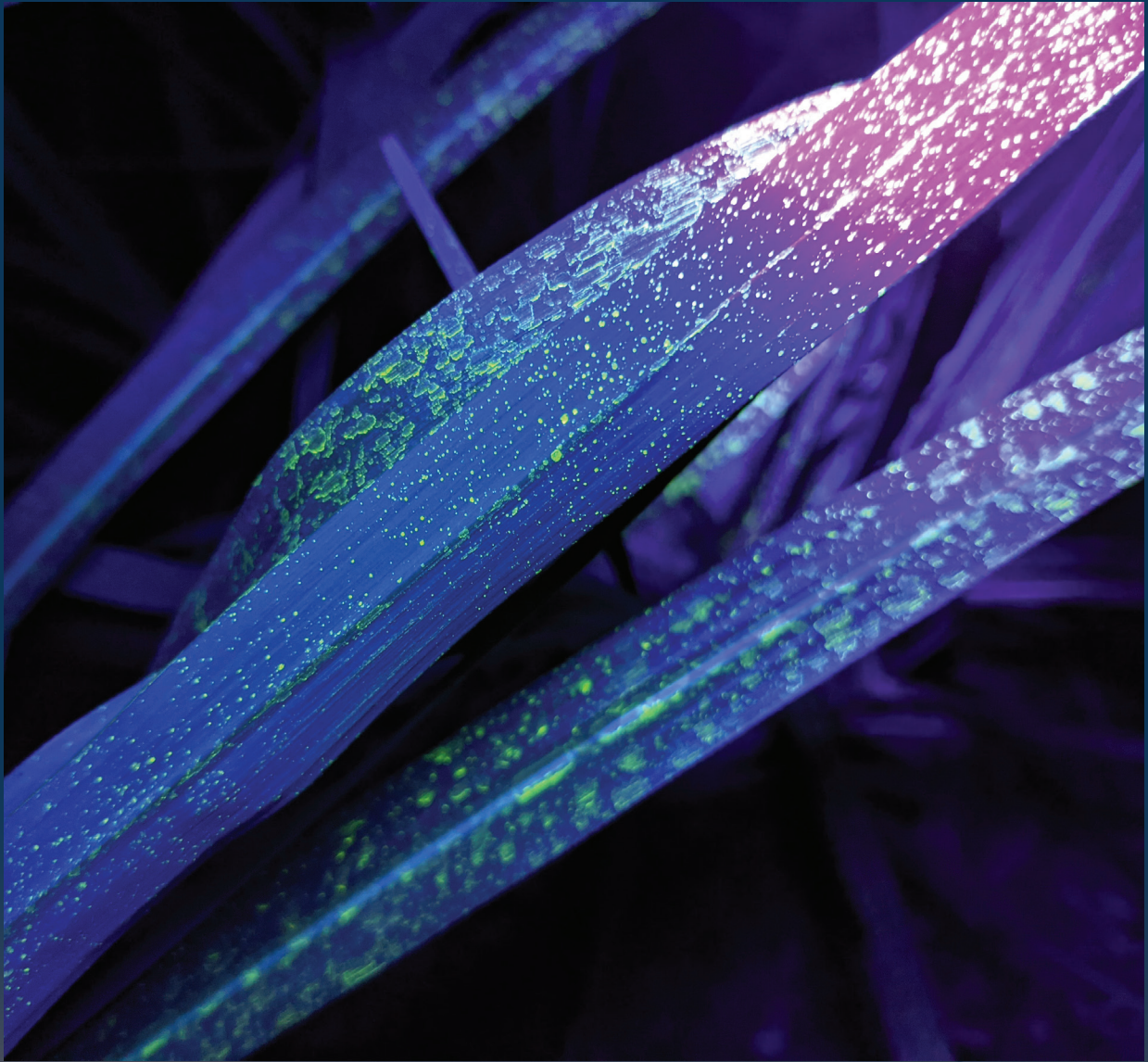
Remote sensing is useful; however, it currently only represents vegetation cover. Additional data on biomass, plant basal area, litter, species diversity, soil health will be important for monitoring land condition changes.

Anecdotal evidence suggests that these grazing strategies are likely to improve the economic outcomes for grazing enterprises in most (but not all) situations. Further work is needed on the costs and benefits of these approaches.

What does this mean for investments in Reef catchments?

This project has provided important data and evidence that changes in vegetation, soil (carbon) and land condition can be achieved using regenerative grazing approaches. Ancillary research suggests that better land condition will lead to improvements in runoff and water quality. This project has provided data and knowledge to support investment in innovative financing schemes such as Reef Credits and the Land Restoration Fund, and strengthened evidence for the broader rollout of these approaches across the Great Barrier Reef grazing systems.

Read the full article: Do regenerative grazing management practices improve vegetation and soil health in grazed rangelands? doi.org/10.1071/RJ22047



Innovative practical in-field demonstrations of spraying equipment to maximise efficiency were used to stimulate grower adoption of new technology and techniques on their farms. Farmacist.





Image Credit James Unsworth



Water Quality Innovation Program Impact Report

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