Advancing Water Quality Improvement in the Great Barrier Reef: Introduction to the Special Edition

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Abstract. This special edition presents findings from the comprehensive evaluation of the Reef Trust Partnership Water Quality Program, the largest investment in Great Barrier Reef water quality improvement to date. Six papers examine critical aspects of water quality interventions across grazing and sugarcane industries in five Natural Resource Management regions. The main findings reveal that achieving lasting water quality improvements is far more complex than implementing technical solutions alone. Key discoveries include widespread practice reversal from previous programs, the critical importance of trust-based relationships and social networks in driving adoption, and the finding that all landscape restoration sites required costly ongoing maintenance regardless of initial effectiveness. Financial incentives can accelerate practice adoption by about three years but work best as accelerators rather than primary motivators, while social diffusion effects from monitoring projects occur but are limited in scope. The tension between the public benefits of water quality improvement and the private costs borne by farmers, suggests that system-wide solutions that address social norms, economic constraints, and institutional factors rather than relying solely on technical interventions are needed. The collection provides Reef water quality decision makers with potential avenues for breaching the gap in current progress and meeting the Reef 2050 Water Quality Improvement Plan targets.

Keywords: Great Barrier Reef, water quality, practice change, landscape restoration, sugarcane, grazing, agricultural extension

Introduction

The Great Barrier Reef, one of the world's most biodiverse ecosystems, faces unprecedented environmental pressures, with declining water quality from agricultural runoff threatening its health and resilience (Waterhouse et al 2024). Sediment, nutrients, and pesticides from grazing and sugarcane farming in the Reef's catchments continue to degrade inshore coral reefs and seagrass meadows. The Reef 2050 Water Quality Improvement Plan (Reef 2050 WQIP) sets targets for reducing sediment, nutrient, and pesticide loads, yet despite decades of investment and intervention through successive government programs, progress towards these targets has been slow (Queensland Government 2022).

Improving water quality is often focussed on the adoption of improved management practices and restoration interventions. In this context, it is important to remember that research in agricultural extension, natural resource governance and innovation studies increasingly highlights that environmental outcomes are shaped by a broader set of social, economic and institutional factors (Schut et al. 2015; Ingram 2018; Leeuwis & Aarts 2020). Water quality improvement has been described as a complex or "wicked" challenge involving multiple actors, competing objectives and considerable uncertainty (Tan and Humphries 2022; Head 2025). Questions of how change is sustained, how stewardship is maintained, and how different actors and institutions interact to support long-term outcomes are therefore key to the improving water quality in the long term.

Despite substantial investment and a growing evidence base, significant questions remain unanswered regarding how water quality improvements can be sustained at the scale required to meet Reef 2050 targets. Considerable attention has been devoted to promoting the adoption of improved management practices (Rolfe and Gregg 2015; Van Grieken et al. 2019; Coggan et al. 2021) and implementing restoration interventions (Condie et al. 2018; Waltham et al. 2024). However, achieving enduring environmental outcomes requires more than the initial uptake of practices or the implementation of restoration works. Research in the Great Barrier Reef and broader agricultural innovation literature has increasingly highlighted the importance of long-term stewardship, social networks, trust, governance arrangements and the interactions between multiple actors and institutions in shaping environmental outcomes (Dale et al. 2018; Olvera-Garcia et al. 2020). Building on these insights, attention has increasingly turned to the challenge of sustaining change over time, including questions of practice persistence, adaptation and reversal (de Oca Munguia et al. 2021). These challenges are not unique to the Great Barrier Reef but reflect broader debates within agricultural extension, innovation studies and sustainability transitions concerning how enduring change can be achieved in complex agricultural systems.

This special issue addresses these challenges through six contributions that examine water quality improvement in Great Barrier Reef catchments from a range of perspectives. While the papers

focus on different interventions and contexts, they are united by a common concern: understanding the conditions under which water quality improvements can be achieved and sustained over time. Collectively, the papers move beyond assessing whether individual interventions work to examine the social, economic, institutional and governance factors that influence enduring change. The contributions explore themes including landscape restoration, long-term stewardship, financial incentives, practice change, social networks, and agricultural innovation systems, providing complementary insights into the challenges of improving water quality in complex agricultural landscapes.

Several of the papers draw on experiences and evaluations associated with the Reef Trust Partnership Water Quality Program, a major investment aimed at accelerating progress towards the Reef 2050 Water Quality Improvement Plan targets. Together with the broader conceptual contribution on agricultural innovation systems, the collection provides an opportunity to reflect not only on the effectiveness of specific interventions, but also on the wider conditions that enable environmental improvements to be maintained and scaled over time.

The Reef Trust Partnership Water Quality Program

The Reef Trust Partnership (RTP), established in 2018 between the Australian Government's Reef Trust and the Great Barrier Reef Foundation, represented the largest single investment in water quality improvement undertaken in Great Barrier Reef catchments, investing $200 million over six years (Department of Climate Change, Energy, the Environment and Water 2022). Delivered through ten regional programs across five Natural Resource Management (NRM) regions, the program sought to accelerate progress towards Reef 2050 Water Quality Improvement Plan targets through a combination of agricultural extension, financial incentives, restoration activities and support for the adoption of improved land management practices.

The breadth of the RTP created opportunities not only to implement water quality interventions at scale, but also to examine the assumptions that underpin them. As a result, the program generated a rich body of evidence concerning the technical, social and institutional dimensions of water quality improvement. Several papers in this special issue draw on findings emerging from RTP-supported activities and evaluations, while others contribute broader conceptual perspectives relevant to understanding water quality improvement in Reef catchments.

Overview of the contributions

In parallel with program delivery, the Great Barrier Reef Foundation implemented a comprehensive monitoring and evaluation framework that examined biophysical, social and economic outcomes across the RTP Water Quality Program (Great Barrier Reef Foundation 2025). Spanning two industries and five Natural Resource Management regions, the evaluation employed a mixed-methods approach that combined quantitative and qualitative methods and drew on both internal and independent external expertise. Beyond assessing program performance, the scale and scope of the evaluation created opportunities to investigate fundamental assumptions that have historically underpinned Reef water quality programs and to address persistent knowledge gaps concerning the effectiveness and longevity of different interventions.

The papers included in this special issue represent a subset of the findings emerging from this evaluation effort, together with complementary research contributions. Collectively, they examine a common challenge: how water quality improvements can be achieved and sustained over time. While the papers focus on different interventions and contexts, they are united by an interest in understanding the technical, social and institutional conditions that support enduring change.

Two papers focus on landscape restoration as a pathway to reducing sediment loads entering the Reef. James et al. (2026b) examines the design and implementation of the RTP Landscape Restoration Program, highlighting both the effectiveness of restoration interventions and the importance of long-term maintenance for sustaining outcomes. Complementing this perspective, Schultz et al. (2026a) explores landholder experiences of streambank and gully restoration projects and the factors influencing their ongoing stewardship. Together, these papers suggest that while restoration can achieve substantial environmental benefits, long-term success depends on continued maintenance, landholder commitment and the integration of restoration activities with broader land management practices.

A second group of papers examines the challenge of sustaining management practice change in the sugarcane industry. James et al. (2026a) demonstrates that well-designed financial incentives, when combined with extension support, can accelerate practice adoption and increase the likelihood of ongoing practice maintenance. Gongora et al. (2026) extends this discussion by examining the phenomenon of practice reversal and identifying factors associated with enduring

practice adoption. The findings highlight the importance of longer-term support, social norms, industry relationships and system-wide conditions that extend beyond individual decision-making.

The social and relational dimensions of practice change are explored further by Cruz and Guerrero (2026), who show how trust-based relationships, peer learning and social networks shape decisions regarding sustainable farming practices. Their findings reinforce the importance of credibility, legitimacy and repeated social interactions in supporting change. Together with Gongora et al. (2026), this work challenges linear models of technology adoption and highlights the socially embedded nature of agricultural decision-making.

Finally, Murray-Prior et al. (2026) provide a broader conceptual contribution through the development of an Agricultural Innovation Systems framework for understanding and promoting water quality improvements in Great Barrier Reef catchments. By emphasising interactions among actors, institutions, governance arrangements and innovation processes, the framework provides a useful lens through which many of the findings presented in the preceding papers can be interpreted.

Taken together, the papers in this special issue suggest that improving water quality is not simply a matter of identifying effective practices or interventions. Rather, enduring outcomes depend on stewardship, incentives, relationships, governance arrangements and broader innovation system dynamics. The collection therefore contributes to ongoing discussions within agricultural extension, environmental governance and innovation studies concerning how complex environmental challenges can be addressed in ways that support lasting change.

Lessons for the future

The challenge of achieving enduring change

Collectively, the papers reveal that achieving lasting water quality improvements is far more complex than implementing technically sound interventions. The evidence of practice reversal presented by Gongora et al. (2026) challenges assumptions that the adoption of improved practices necessarily leads to enduring change. Similarly, the restoration papers demonstrate that successful implementation of restoration works does not guarantee long-term outcomes unless ongoing stewardship and maintenance are sustained (James et al. 2026b; Schultz et al. 2026a). Across both industries, the findings suggest that the initial uptake of practices or interventions should be viewed as the beginning rather than the endpoint of the change process.

The role of relationships, trust and stewardship

A consistent theme across the papers is the importance of relationships, trust and social processes in shaping environmental outcomes. Cruz and Guerrero (2026) demonstrate that practice adoption is embedded within trust-based social networks, while Gongora et al. (2026) highlight the role of social norms, industry relationships and extension support in sustaining change over time. The restoration studies similarly point to the importance of ongoing stewardship and landholder commitment in maintaining environmental outcomes. Together, these findings suggest that future initiatives should move beyond information transfer and place greater emphasis on fostering trusted relationships, peer learning, local leadership and long-term engagement. Enduring change depends not only on what farmers know, but also on who they trust, how they learn, and the social environments in which decisions are made.

Water quality improvement as an innovation systems challenge

Taken together, the papers suggest that improving water quality is best understood as an agricultural innovation systems challenge rather than solely a problem of technology adoption or program delivery. The Agricultural Innovation Systems framework proposed by Murray-Prior et al. (2026) provides a useful lens through which the findings of the other papers can be interpreted. The challenges identified throughout the collection—including practice reversal, stewardship of restoration works, the limits of financial incentives, workforce constraints, conflicting advice from commercial actors, and the importance of trust-based networks—are not isolated issues. Rather, they emerge from interactions among farmers, advisors, researchers, industry organisations, resellers, policy makers and governance arrangements. Addressing these challenges therefore requires more than improving individual programs. It requires attention to the broader social, institutional and economic conditions that enable environmental improvements to be maintained, scaled and embedded within agricultural systems.

Conclusion

This special issue contributes to growing debates within agricultural extension, environmental governance and innovation studies concerning how enduring environmental change can be achieved in complex agricultural landscapes. Drawing on empirical and conceptual contributions

from Great Barrier Reef catchments, the papers demonstrate that while technically effective solutions for improving water quality exist, their long-term success depends on stewardship, relationships, incentives, governance arrangements and broader innovation system dynamics.

The findings come at a critical time as governments continue to review and refine strategies for achieving Reef 2050 Water Quality Improvement Plan targets. By examining both the effectiveness and the longevity of interventions, the papers move beyond questions of whether particular approaches work to consider the conditions under which change can be sustained. Collectively, they suggest that achieving transformative improvements in water quality will require not only technical innovation, but also sustained investment in the social, institutional and governance processes that underpin enduring change.

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