Prioritisation in practice: Targeted extension in Great Barrier Reef water quality improvement programs

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Abstract. Prioritisation of investment in improving water quality outcomes for the Great Barrier Reef requires a practical perspective of the community landscape in which programs are delivered. Water quality science is improving investors understanding of landscape processes which influence efficient targeting of resources. This paper aims to improve understanding of the social process which may influence efficiency. It presents learnings and observations from the perspective of delivering a targeted sugarcane agricultural extension program across the Wet Tropics. Importantly, this program has continued to find the need to understand and align with local community and industry dynamics to ensure prioritisation supports the intended outcomes, including that communities and landholders are actively engaged in water quality improvement and remain resilient.

Keywords: agricultural extension, prioritisation, water quality, Great Barrier Reef, Social Network Analysis.

Introduction

Prioritisation in agricultural extension for reef water quality improvement can, and should, consider the human dimensions of local communities and industries, in addition to the technical understanding of landscape processes and practices which contribute to water quality risk. Many local level physical and social characteristics that influencing decisions about prioritising extension effort and its likely impact will be discussed here. This project's experience demonstrates that place-based program design is most likely to effectively prioritise limited extension resources to realise maximum water quality outcomes while maintaining resilient and capable diverse rural communities in the Wet Tropics.

The learnings presented here come from a successful reef extension project in the Wet Tropics Natural Resource Management (NRM) region of Far North Queensland. It was delivered through the Wet Tropics Sugar Industry Partnership's co-operating 17 organisations, representing the entire region's sugar industry as well as NRM and Queensland Government bodies, covering all six distinct sugar milling districts. The three-year Reef Trust program invested in agricultural extension as the primary strategy to encourage low water quality risk farming practices, reaching its targets and resulting in reduced Dissolved Inorganic Nitrogen (DIN) and sediment loads flowing to the Great Barrier Reef.

Prioritisation in Great Barrier Reef water quality improvement programs

Reef management and protection is a priority for the Australian Government, reflected in the development of the *Reef 2050 Long Term Sustainability Plan* (Australian Department of Environment and Energy 2018a). Informing this plan and its subsequent implementation are several policies and reef programs including the Scientific Consensus Statements, *Reef 2050 Water Quality Improvement Plan* (WQIP) (Department of Environment and Science, Queensland 2018) and Paddock-to-Reef's Water Quality Risk Frameworks. Investment in reef water quality outcomes has come from a range of sources including the Australian Government's Reef Trust, the Great Barrier Reef Foundation's (GBRF) Reef Trust Partnership and the Queensland Government's Office of the Great Barrier Reef (OGBR).

The Australian Government's Reef Trust Phase III (RTIII) "Growing a Great Barrier Reef" project, delivered by the Reef Alliance, is an example of a water quality improvement program, one of the first to focus on agricultural extension as the primary mechanism to contribute toward WQIP targets. Prioritisation is increasingly valued by investors aiming to demonstrate greater efficiency and return on investment. The *RTIII Investment Prioritisation Guide* (Commonwealth of Australia 2015) described priority farm practices and required programs to target priority pollutants in line with catchment priorities from regional WQIPs the overarching *2013 Scientific Consensus Statement* (Reef Water Quality Protection Plan Secretariat 2013). Regionally, investment was informed by a practice prioritisation strategy, local hot-spot mapping (made searchable through the 'Reef Decision Support Tool beta') and increasing use of the Paddock-to-Reef (P2R) Projector tool v.1, all underpinned by the P2R *Sugarcane Water Quality Risk Framework* (Department of Environment and Science, Queensland 2019). Prioritisation intended to ensure extension effort contributed to the greatest pollutant load reductions.

While water quality science is improving the understanding of landscape processes which influence efficient targeting of resources, learnings and observations from the perspective of delivering a targeted sugarcane agricultural extension program across the Wet Tropics demonstrate it is important to understand the social landscape as well. Good water quality science informs WQIP catchment targets and advanced modelling helps identify landscape water quality risk hotspots. The scale at which there is confidence in models is improving all the time. This science is invaluable, however prioritising resource investment to support effective agricultural extension with long term outcomes for reef water quality improvement requires an understanding and consideration of the human landscape in which people live and work, in addition to the landscape processes affecting the movement of contaminants to the reef.

Where investment is narrowly limited by defined landscape features, for example catchments or 'hotspots' there is a risk that widely influential individuals or organisations who are part of the community and regional industry landscape will be excluded. Similarly, where narrow targets and methods of demonstrating outcomes are defined by projects, more holistic, grower centred extension approaches are also constrained. These characteristics present a challenge to the possibility of achieving social change and long-term water quality improvement. The importance of continuity and collaboration identified in numerous reports and previous strategies (Department of the Premier and Cabinet, Queensland 2010; Coutts et al. 2017) and the need for place-based, local approaches to prioritisation and program design over a 'one size fits all' decision making process was re-affirmed by this agricultural extension program.

A Wet Tropics sugarcane extension experience

In the Wet Tropics a three-year RTIII program (2016-2019), funded by the Australian Government, invested in agricultural extension in the sugar industry as the primary mechanism to support the adoption of lower water quality risk farm practices and reduce DIN flowing to the Great Barrier Reef. This program took a novel approach with its focus on extension, building on previous reef programmes across the region which had primarily used incentive grants to drive change. The program successfully achieved an estimated reduction in sugarcane DIN of over 266T, reduced across the Wet Tropics, reaching program targets.

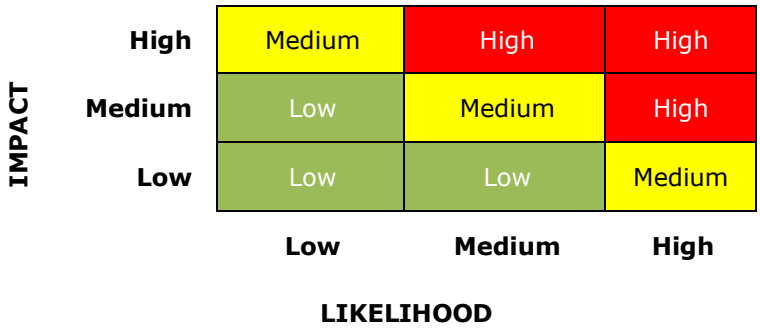
The practicality of applying the *Reef Trust Phase III Investment Prioritisation Guide* (Commonwealth of Australia 2015) through the development of a regional prioritisation framework for extension practice was investigated through local district-scale workshops to incorporate an understanding of the human dimension influences. Once extension officers were established in local districts and in their host organisations, approximately 18 months into the project, the team had the opportunity to conduct district scale prioritisation planning with local extension teams (including service providers and district extension staff). Being established meant there were staff with a range of experience and understanding of local communities, the challenges and motivations for individuals in their community, industry relations, networks and more.

In these workshops water quality hotspots on photographic maps were used to create a picture of the human landscape and describe the factors affecting prioritisation in practice. We overlayed local 'hot-spot' mapping, which highlighted moderate and high priority locations (i.e. those with highest water quality risk based on modelled losses of sugarcane DIN/ha), with spatial mapping of current landholder engagement. The team then used a community network analysis approach to delve into who, where and how water quality improvements could be gained. Extension officers developed a picture of the social network in their district, were able to identify individuals, and cluster groups in 'hot spots' who were not yet engaged with the RTIII program. The extension team also explored the network structure, influencers (identified as individuals, organisations and other programs in some cases) and their own personal sphere of influence within the network. This approach allowed individuals to work together across the extension network to identify who was best placed to make initial contact with growers and where cluster groups existed, essentially recognising and building on the essential extension-grower relationship. This step also went some way toward reducing potential duplication for growers and improving collaboration across the extension network.

Initially the district extension workshops also aimed to produce a Wet Tropics decision support matrix to assess likely impact against effort required (Figure 1) to assist with extension work-planning in the short program timeframe. The team found however that a generic region wide matrix could not be developed to adequately inform prioritisation across the six diverse cane districts in the Wet Tropics. They reaffirmed the need to adopt a place-based approach, finding it was important to recognise social dynamics and local district characteristics and to build on the experienced local extension network's understanding of farming communities. The workshops did yield of a list of characteristics influencing decision-making, including how some of these affected

the attributes which determine impact, effort and likelihood of success. This understanding was used to inform district work-planning which replaced earlier generic region-wide workplans.

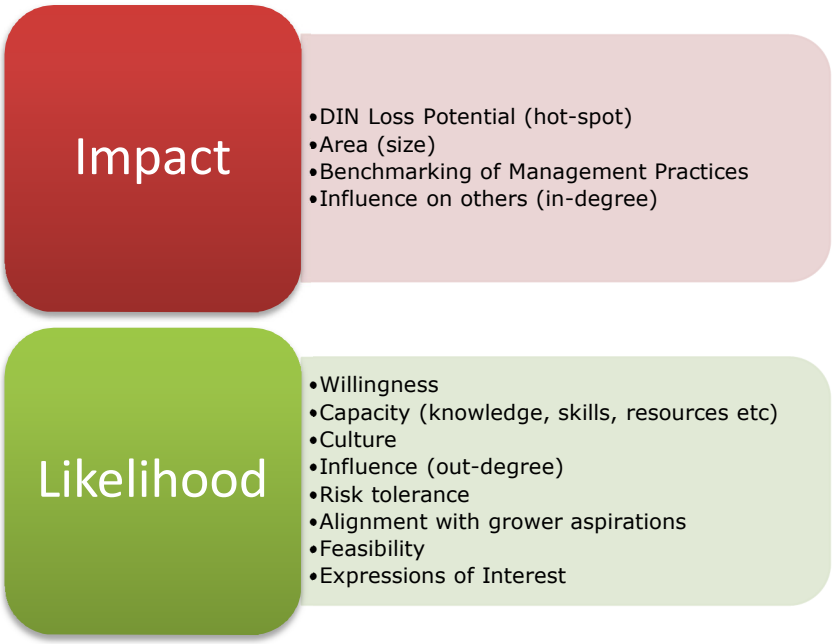
Figure 1. Decision support matrix for prioritisation



Prioritisation in practice

Through exploring social networks and landscape priorities in the district workshopping activity the team was able to identify and develop a framework to inform local scale decision making based on a 'risk assessment' style matrix. At a regional scale this framework identified a set of attributes which determined both the likelihood of an engagement resulting in a water quality outcome, and the impact of that outcome in terms of progress toward DIN reduction targets. Importantly however, this framework could not be applied at a regional scale as several place-based characteristics significantly influence the relative weighting of each attribute. For example, the likelihood of an engagement resulting in a water quality outcome can be influenced by local characteristics such as; the capacity of extension services across the district and the length of time individual extension officers have worked in that district, the level of trust in individuals and in programs, previous experience with similar programs, the number of other services/organisations/programs in the district, consistency of messaging, average farm sizes, grower demographics and much more. Some of these are summarised in Figure 2 and described in more detail below.

Figure 2. Attributes influencing impact and likelihood



Likelihood

Attributes that determine the likelihood of a successful water quality outcome from prioritising extension effort with particular individuals or groups included (but were not limited to):

- *Willingness* – a landholder's willingness to engage with an individual extension officer, to be involved with a specific service provider/host organisation or program. Willingness may be influenced by previous experiences and success/failures, trust and motivations.
- *Capacity* – the degree to which landholders have the fundamental understanding, knowledge, skills and resources to take the action being recommended. Furthermore, do they have the confidence and self-efficiency to make informed decisions?
- *Culture* – the traditions and culture of the community, industry, family and social norms.
- *Influence* (out-degree) – in Social Network Analysis (SNA), a measure of how many others are influencing an individual's decisions. Does the landholder trust and/or value strongly the advice of the extension officer or do they canvas a wide range of input before making decisions?
- *Risk tolerance* – the landholder's tolerance for trying new things, an attribute in itself affected by external factors like commodity prices, age and aspirations for future etc.
- *Alignment* (of program objectives) with grower aspirations.
- *Feasibility* – the practicalities of adopting recommendations, for example access to specialised equipment, mill mud, contractors, costs etc.
- *Expressions of interest* – where there is existing demand for particular extension services or waiting lists the likelihood of success from an engagement may be high.

Impact

Attributes which determine the impact on outcomes in terms of progress toward water quality outcomes included:

- *DIN Loss potential* – mapped hot-spots identifying highest WQ risk based on modelled losses of Dissolved Inorganic Nitrogen/ha.
- *Area* – the physical size of a landholder's property, particularly within hotspots.
- *Benchmarking of Management Practices* – a landholder's current farm management practices based on Paddock-to-Reef's benchmarking questions. The current farm management determines what scope there is for improvement.
- *Influence on others* (in-degree), in Social Network Analysis, a measure of how many others in the community look to them for advice and/or are influenced by them. A landholder with a high in-degree may be considered a network influencer and should be a priority for engagement.

Place-based characteristics - describing district variation

Significantly several place-based characteristics influence the relative weighting of the above attributes at a local scale. These characteristics include aspects of the social, economic, environmental and political context as they affect and shape local areas and individual programs. Although by no means an exhaustive list, some of these characteristics are listed here:

- experience and capacity of the extension network across a district, including the type and availability of services for agronomy, productivity, pest management, research etc.
- capacity and number of organisations working with landholders in a district
- average size of farm units
- average distance from mill
- geo-physical characteristics (e.g. dominant soil types, slope, rainfall)
- quantum of investment for specific projects
- length of project investment
- overlapping or competing projects, particularly when run by different organisations within a district, compounded by the requirement to 'attribute' outcomes to individual investments
- social networks and relationships, both between landholders and with industry bodies and extension providers
- harvesting contractors, including the number, size, availability, type of equipment, or timing etc.
- industry network's size and composition e.g. in one district there is a 'one-stop-shop' for most productivity services, fertiliser and chemical sales as well as delivery of government reef programs whereas in other districts these are provided by separate entities.

Place-based prioritisation - examples

Using the framework for understanding impact and likelihood described above, the following two examples demonstrate how local characteristics in different sugar growing districts influenced the prioritisation decisions made for extension delivery in a 3-year program.

Example One

In a district where almost all of the landscape was characterised as a 'hot-spot' i.e. a high priority due to geo-physical attributes resulting in a high DIN loss potential across the catchment, there

was no need to interrogate maps to identify specific hotspots first. Instead a farm's area was weighted as the having the greatest influence on potential impact. Therefore, this district's workplan identified targeting extension effort toward the largest landholders first as the priority, as well as those who had the greatest area of influence on others (identified through community network analysis and an understanding of the local industry landscape, e.g. harvesting contractors). Other factors such as the landholder's current management and potential for adoption of priority practices would then be identified to understand where extension services could contribute most to alignment with growers' needs and aspirations as well as delivering water quality outcomes.

This district is also characterised by its relatively small extension network and the fact that several large landholders manage most of the cane area. In this district there is one service provider established as essentially a "one-stop-shop" providing easy access to most landholders and with little overlap from other providers or programs. Given these characteristics it was determined that investing a greater effort with these identified landholders would provide the greatest impact on water quality outcomes and be most likely to influence long-term change across the district. The district workplan also supported the team to utilise opportunities for wider engagement through topical workshops and other extension activities aimed at groups rather than individuals for greater efficiency.

Example two

In another district, where distinct priority landscape hotspots exist, this attribute was weighted as having the greatest influence on impact and so these locations were prioritised before considering farm size. The extension workshop also undertook social network analysis, drawing lines on physical maps to explore the relative influence of growers in their district which highlighted the need to prioritise maintaining extension relationships with influential growers regardless of the location of their property relative to hotspots. In this very large district there are far more growers, with farms of varying sizes, than the extension officers delivering the RTIII project could reasonably service. The characteristics of the program and local district, including the available funding, number of growers and available extension capacity therefore meant it was important to prioritise and identify realistic expectations for the officers employed for this project.

This district is characterised by its size, diversity and relatively large extension network with a range of specific skills. Attendees at the district level extension workshop used social network analysis to identify clusters of growers in priority locations and key influencers who had not yet been engaged in the RTII program. Extension officers also explored their personal sphere of influence, locating each of the landholders identified within a series of concentric circles with themselves at the centre. This exercise, undertaken with a co-operating network of extension officers beyond the RTIII team facilitated collaboration to reduce duplication for growers and identify which extension staff were best placed to target landholders in priority locations.

The network used their extensive understanding of the local community to identify specific capacity building needs, targeting a group of growers who were part of an identified hotspot grower cluster. The team drew on the range of skills in their extension network to develop a series of 'back to basics' workshops to develop grower capacity and confidence around nutrient management. They used a personalised approach to invite landholders to participate in a series of short, field-based workshops which were very well received. District characteristics, including the high level of extension capacity and range of specialised skills, contributed to the success of this extension approach.

Implications

Currently, most reef programs are characterised by similar limitations, of time, funds, and increasing demands of operational efficiency, return on investment (ROI) and attribution of water quality outcomes. Alluvium (2019) reiterate that lack of continuity, duplication of effort and unrealistic timelines all serve to increase costs (and therefore reduce ROI). These limitations influence program design and limit the realisation of long-term water quality outcomes. Currently for most new programs, with relatively short time frames (less than 5-7 years), narrow parameters (e.g. catchment priorities) and limited funds, delivery partners need to prioritise effort with a focus on immediate impact to demonstrate ROI for investors. As a result, it is logical that the 'low hanging fruit' are targeted first (i.e. most willing landholders). This approach helps to get new programs and staff established with early wins and serves to build momentum. It is also likely that large landholders will be prioritised in this scenario to ensure targets for area are met quickly. The emphasis on narrow parameters for demonstrating ROI can also encourage attribution competition, reduce collaborative approaches and stifle innovative extension techniques. Extension officers delivering specific programs in this kind of environment face

challenges building and maintaining grower trust and personal credibility, overcoming grower fatigue as well as uncertain career progression prospects. Landholders targeted by these programs often do not have their needs or aspirations acknowledged in the design phase and may be faced with numerous competing and sometimes conflicting programs and new faces vying for their time.

In contrast, a longer program, or programs designed to continue and build on existing investment, utilising a place-based collective design approach do not require the same start-up strategy and lag times. 'Low hanging fruit' are no longer a necessary priority as established trust and extension relationships allow for more sophisticated targeting of effort and development of tailored extension strategies to address barriers affecting likelihood e.g. building capacity, demonstrating feasibility, better alignment of project outcomes with landholder objectives, and the development of collaborative strategies to support smaller landholders to overcome barriers. Investment with these kinds of characteristics has the potential for broader engagement where impact is likely to be higher and longer lasting.

Often, experienced extension officers make decisions about prioritising effort intuitively thanks to each network's understanding of local farming communities. It is however useful to document the attributes and local characteristics which influence decision-making and prioritisation to encourage greater consideration by future investors and program designers aiming to implement efficient, targeted programs which deliver long term outcomes for water quality. We propose that investors and program designers will likely contribute to more successful extension programs where:

- there is a good understanding of all the characteristics influencing program design including scientific, social, policy, community and industry considerations
- co-design using place-based planning approaches that are adaptable, not top-down, prescriptive and/or 'one size fits all' are central tenets
- duplication of investment effort is reduced by adopting collaborative approaches with a long-term view
- the ongoing capacity of extension networks is supported, where extension officers have career certainty and are not tied to specific project delivery
- programs are designed locally to align with local community and industry aspirations
- the importance of continuity and long-term approaches are recognised to support both agricultural cycles (5-7 year in sugar cane for example) and behaviour change processes.

Recommended further research

Program design and investment decisions could be enhanced by further research into both the influence of place-based and program specific characteristics discussed here as well as trialling potential solutions to overcome some of the limitations such as short time frames, having overlapping or competing programs, continual cycles of re-establishment of staff etc. This change may require a complete shift in current funding models and attitude by investors. Some suggested topics for research to build on the learnings from prioritisation in practice include:

- development of simple methodologies for understanding influence and community networks, including for extension officers to place themselves within these contexts
- continuing to develop water quality risk modelling at a finer scale to improve confidence in spatial prioritisation
- review of historical program delivery and documenting cycles of re-establishment, associated costs and grower fatigue
- trialling potential solutions, for example alternative funding models, frameworks to support the maintenance of extension capacity (rather than the continual re-employment of extension officers who end up employed as project officers) and multi-source attribution methods
- understanding how many landholders an extension officer can effectively maintain trusted relationships with and provide quality services for
- establishing how the length of funding cycles and projects affects the relative weighting of different decision-making attributes
- developing a greater understanding of the above-mentioned attributes and influencing characteristics to improve the utilisation of place-based program approaches

Conclusion

Sharing the learnings from the practice of prioritising extension effort is important to contribute to the broader published literature on the characteristics affecting efficiency and outcomes for investors. This includes understanding the importance of continuity, trust and relationships, credibility, influence and approaches which build capacity and resilience within industry and communities. The examples provided here have demonstrated that a range of attributes can be

considered to evaluate impact and likelihood of outcomes, influencing the prioritisation decisions made in a water quality improvement program aiming to contribute to WQIP targets. Furthermore, there are a range of characteristics including social, economic, environmental and political contexts at multiple scales which affect the weighting of attributes evaluated in the decision making process. These findings continue to support the need for locally designed approaches to water quality improvement.

There is a need for further research and a greater understanding of how to design programs which incorporate the human dimensions of local landscapes and communities in addition to the technical and scientific approaches currently informing water quality risk and landscape prioritisation. Addressing some of the limiting characteristics of programs would provide an opportunity to reduce the duplication of effort at a local scale and more effectively prioritise the extension resources being invested in water quality improvement and Reef sustainability outcomes.

References

Alluvium 2019, *Effective and efficient pathways for investment in improved water quality in the Great Barrier Reef: Final report,* A report for the Great Barrier Reef Foundation, Brisbane, Qld, Available from: <https://www.barrierreef.org/> [25 October 2019].

Australian Department of Environment and Energy 2018, *Reef 2050 long term sustainability plan*, Available from: <http://www.environment.gov.au/marine/gbr/publications/reef-2050-long-term-sustainability-plan-2018> [24 October 2019].

Commonwealth of Australia 2015, *Reef Trust Phase Three Investment Prioritisation Guide,* Available from: <https://www.environment.gov.au/> [24 October 2019].

Coutts JR, Murray-Prior R, Long P & Coutts B 2017, *Review report: practice change, education and extension in reef catchments project*, Available from: <https://www.qld.gov.au/> [17 October 2019]

Department of Environment and Science, Queensland 2018, *Reef 2050 water quality improvement plan,* Available from: <https://www.reefplan.qld.gov.au/water-quality-and-the-reef/the-plan> [24 October 2019].

Department of Environment and Science, Queensland 2019, *Sugarcane water quality risk framework 2017-2022*, Available from: <https://www.reefplan.qld.gov.au/ > [21 October 2019].

Department of the Premier and Cabinet, Queensland 2010, *Extension and education strategy: 2020 focus on best practice,* Reef Water Quality Protection Plan Secretariat, Brisbane.

Reef Water Quality Protection Plan Secretariat 2013, *2013 scientific consensus statement: Land use impacts on Great Barrier Reef water quality and ecosystem condition,* Available from: <https://www.reefplan.qld.gov.au/> [24 October 2019].