

What does success look like? Emerging lessons for successful natural resource management

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Acknowledgement of Country

We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present.

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Executive Summary

Numerous people and organisations (including, but not limited to Australia's Landcare groups, threatened-species recovery teams, and NRM organisations) support and undertake on-ground activities that contribute to conservation and restoration. The conditions that support these people and organisations can vary between places and across activities; and the ecological, social and economic outcomes of their efforts are inherently interconnected. But relatively little is known about what works best, for whom, and in which contexts. Working in partnership with the National Landcare Network (NLN), the Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW) and NRM Regions Australia, this project set out to identify factors associated with positive outcomes to help inform how future NRM programs are designed, monitored and supported. Specifically, it examined:

- The ecological, social, and economic outcomes people felt their activities achieved
- How different people and organisations contributed
- Which resources, conditions and events were thought to have enabled or hindered positive outcomes and
- The factors that influence people's desire to stay involved over time.

Having established the importance and difficulty of demonstrating 'success' in a complex and highly connected system (Section 2), researchers undertook a systematic literature review and blended insights from diverse disciplines (Section 3), to develop a conceptual model of 'success', which was then used to guide the compilation of data and analysis of data. They co-designed an on-line survey and collected information from people involved in delivering natural resource management projects about the activities their members have been involved in across Australia (Section 4) and integrated that information with other publicly available data, analysing it using a variety of statistical methods.

Before presenting a summary of our results, we flag three important caveats:

- Our findings are drawn from 244 voluntary survey responses concerning activities across 47 NRM regions. The survey data describes our respondents' experiences and their perceived outcomes; they should not be interpreted as representing the views of all people involved in Australian Landcare or NRM activities
- Only 8 respondents identified as being of Aboriginal or Torres Strait Island descent. Our data cannot and should not be used to draw any conclusions about First Nations definitions of success or Caring for Country and the 48 activities that people describe as having some sort of link or association with Aboriginal or Torres Strait lander groups should be treated as providing First Nations evidence – research that seeks to identify 'success' in that context would need to be led by the relevant Traditional Owners and First Nations organisations
- Our statistical analyses identify associations; they do not 'prove' causation.

Those points aside, our research shows that the success of NRM projects and programs is more than achieving environmental outcomes alone, with four emerging lessons:

1. **It is important to measure more than one kind of success** (Section 6). Success is multidimensional. The success NRM projects goes beyond environmental outcomes alone. Analysis of the survey data indicates that: ecological, social and economic

outcomes are positively connected; and that social and ecological outcomes contribute to how people perceive the overall success of an activity.

2. **It is important to match monitoring to when outcomes emerge and to focus scarce monitoring resources on things that are meaningful but difficult to observe** (Section 6). Social outcomes may emerge early and be relatively easy for practitioners to assess, while ecological changes can take longer and may be harder to observe. After collecting baseline data, monitoring can therefore be tailored to different stages of a program with, for example, early social indicators used to complement continued ecological monitoring, and with appropriate resources and support for those collecting the evidence. When resources are scarce, it may be prudent to concentrate most effort on measuring things that are meaningful yet difficult to see, asking on-ground practitioners to report the easier-to observe outcomes, while ensuring that monitoring systems do not require those practitioners to do more, without matching support.
3. **It is important to support complementary and interdependent roles and activities** (Section 5)
NRM initiatives rely on different actors making complementary and interdependent contributions at property, community, regional and institutional levels. Participation numbers, alone, will thus provide an incomplete picture of success. Our findings highlight the importance of enabling and supporting diverse groups to play complementary and interdependent roles for system-wide sustained success – with needs varying across space and over time.
4. **Context influences success and sustained engagement**
Resources, experiences, place and unexpected ecological, social or economic events can all influence outcomes (Section 7). They may also affect whether people want to stay involved or participate in similar activities again (Section 8).

What could this mean for NRM?

Documenting and designing for success thus requires that one takes both a whole-of-system and a targeted view for individual actors and activities. More specifically, these findings point to several practical considerations for designing and evaluating community-based NRM programs:

- **Define success broadly** – success goes beyond environmental outcomes alone. Consider social and economic outcomes in addition to the ecological outcomes and avoid focusing on just a narrow group of outcomes (e.g., only ecological) or a single metric (e.g., the number of trees planted).
- **Match monitoring to the program/activity** – use a sequence of indicators that reflect how long different outcomes may take to emerge and focus resources on outcomes that are meaningful, yet hardest to observe.
- **Recognise different contributions** – support the interdependent roles of landholders, volunteers, coordinators, advisers, managers and funders to undertake complementary activities.
- **Consider the wider context** – take social, economic, institutional and environmental conditions into account when interpreting outcomes.
- **Allow programs to adapt** – build in flexibility to respond to unexpected events and changing conditions.

Summing up and potential ‘next step’

The success of Australia’s NRM system, and the multitude of programs and activities contained within, is inherently multidimensional in that positive environmental change requires both social and ecological successes. As such, sustained, system-wide success requires that a wide range of ‘actors’ undertake complementary activities. Documenting, and designing for, success thus requires that one takes both a whole-of-system view (to plan for and develop a suite of complementary activities and monitoring/reporting strategies) and a targeted view to plan for, report on, and support the diverse activities undertaken by individual actors. Monitoring and reporting frameworks could seek to highlight their multidimensional successes using a tiered (time appropriate) system whilst also recording ‘unexpected’ ecological, social and economic events. The data collected in such frameworks could also be used in whole-of-system evaluations, helping to avoid erroneously attributing changes to specific activities that might, instead, be attributable to other (otherwise unobserved) factors.

Whilst recognising that the specific data requirements are context/activity dependent, our findings suggest that it may be useful to trial a generic monitoring framework, that records ecological, social and economic variables that describe context, activities and outcomes, relevant to diverse ‘actors, and measured at multiple points of time. This would ensure that the monitoring data captures relevant system-wide information, that diverse groups could use to demonstrate and assess outcomes, helping to inform the design of future activities, programs and portfolios and providing high-quality information to inform subsequent evaluations. We invite researchers, partners and willing groups to test our proposed reporting ideas in a few pilot test-cases across different contexts, perhaps collaboratively reviewing the burden, usefulness and evidence quality (for different actors, organisations and activities), then adjusting it in response to that review, before adopting more widely.

1 Introduction

1.1 Aim

The ‘coupled’ climate and biodiversity crisis is significantly impacting many, if not most, communities (Pörtner et al., 2023) and the related escalating environmental challenges, including land and habitat degradation (Izah et al., 2025), have highlighted the critical need for effective Natural Resource Management (NRM) – considered here to describe the coordinated management of natural resources, encompassing land, water, soil and animals which aims to sustain and enhance these resources for future generation (Robinson and Carson, 2013). There is an ever-increasing need for effective on-ground NRM activities, undertaken by diverse groups of land holders, communities and volunteers (Stepenuck and Green, 2015), that support sustainable farming practices, restore landscapes, reduce carbon emissions, improve biodiversity and protect threatened species.

But the demand for resources to support on-ground NRM activities far outstrips supply (Deutz et al., 2020), and the significant challenges of predicting, monitoring, and documenting outcomes from different natural resource management initiatives makes it exceedingly difficult to determine how best to direct scarce resources for greatest ecological outcome. This can lead to perverse outcomes. For example, carbon markets are nowadays a common means of trying to channel resources to support on-ground activities (Denton et al., 2020, Zhang et al., 2019, Guix et al., 2022) but significant problems have been identified in some markets (Pearse and Böhm, 2014) and several major certification schemes have failed to generate (carbon) credits that are deemed ‘of sufficient quality’ to satisfy requirements detailed in the Paris agreement (Kreibich and Hermwille, 2021). Biodiversity markets are growing in popularity but are likewise far from perfect (Griffiths et al., 2019, Devictor, 2015, Bull et al., 2015, Peterson et al., 2018, Niner et al., 2017, Lukey et al., 2017, Tarabon et al., 2021, Tupala et al., 2022).

Perhaps unsurprisingly, many public and private funders are nowadays wanting more audit and assurance checks, requiring that NRM projects and activities demonstrate success, or, when applying for funding, demonstrate they have a good chance of success. But demonstrating success, and designing activities that are most able to achieve success, is a non-trivial problem that governments, organisations and others have been grappling with for decades.

1.2 Research gaps and report structure

More than 30 years of research has generated a wealth of information about factors that contribute to, or detract from, the success of various natural resource management (NRM) initiatives, (Keith, 2023, Ross et al., 2009, Martin et al., 2021, Measham et al., 2011, Curtis et al., 2000, Sobels et al., 2001, Commonwealth of Australia, 1997, Campbell et al., 2017, Garnett et al., 2018, Black et al., 2011, Woinarski et al., 2017) and compilations/reviews of research which identify critical factors (Doerr VAI et al., 2018, Broadhurst L. et al., 2023, OECD, 2021, Doerr VAI. et al., 2017, Taylor et al., 2022, Walsh et al., 2019). However, most previous research has focused on a relatively small part of the entire NRM system (e.g., a single type of activity, or a single group, or a single type of outcome). Consequently, our ability to use that work to generalise about the ‘success’ of diverse activities, or to identify core factors that contribute to success (with subsequent

In this report we focus on the joint problem of demonstrating and designing for success.

insights for design) in what is a complex, highly connected social-ecological system (SES) is hampered by knowledge/information gaps. Each of the gaps identified below, are addressed in a separate section of this report.

- 1) Whilst there is a long and deep history of research that seeks to ‘value’ landscapes or parts thereof (sometimes, but not always using money as a metric), relatively little attention has been given to the more challenging task of trying to ‘value’ NRM-type activities that are intended to create positive environmental change in complex social-ecological systems. Section 2 provides a summary of one of these project’s published articles, Stoeckl et al. (2025), which discusses that issue, flagging the need to use methods that allow for interconnectivities, since NRM projects happen in highly connected and complex systems.
- 2) Most previous research has focused on either social issues or ecological issues, without blending insights across disciplines to further grow our understanding of success factors in complex, connected, social-ecological systems. Section 3 provides a summary of one of these project’s published articles, Limenih et al. (2026), a systematic literature review that helps fill that gap by qualitatively blending insights across disciplines, and highlighting the critical importance of empirical work to further test inferences.
- 3) With a few notable exceptions (Engert and Laurance, 2023, Commonwealth of Australia, 1997, Bottrill et al., 2011) most assessments of NRM activities or program have focused on just one or 2 groups/organisations or on just a few locations or regions/states and because the different assessments have collected information about different things, in different ways, and at different times, there is a consequent mis-matching of variables and datasets across study sites. This makes it all but impossible to compare the impact of different activities undertaken in different areas (Campbell et al., 2017) or to aggregate data to get a ‘bigger picture’ that allows one to learn more about what works best in which contexts (Hansen et al., 2019). Section 4 discusses how this project helped fill that gap by working with partners to co-design a survey and then collecting data about people’s perceptions of the multi-dimensional ‘successes’, barriers and enablers, for a diverse array of NRM activities undertaken across Australia. Human ethics prevents us from being able to make the data publicly available, but descriptive statistics of key variables are provided in this section. More sophisticated analyses of the data were undertaken, with results reported on within subsequent sections of this report.
- 4) Most empirical social research that focuses on NRM collects and analyses data from a single stakeholder group (e.g. farmers, volunteers; Greiner, 2015, Measham and Barnett, 2008), or about a particular initiative, organisation, or location, and tends to examine implementation outcomes rather than broader system structure (Bennett, 2016). There is limited empirical understanding of how diverse actors cluster within a shared NRM system, about the kinds of initiatives they participate in, and how those participation patterns reflect the complementary roles required to create and sustain resilient ecological systems. Section 5 helps fill that gap, providing a summary of one of these project’s articles, Tsai et al. (in review), which analyses data collected from diverse actors in the on-line survey described in Section 4. This work moves discussions beyond those that treat actor groups as separate stakeholder categories to discussions capable of generating deeper insights about the way in which their contributions collectively support ecological gains across scales.
- 5) Much is known about factors that contribute to various social successes (such as participation, increased knowledge, increased social capital) and much is known about the biophysical measures needed to create positive environmental change, but the siloing of much socioeconomic and biophysical research (Limenih et al., 2026) means that there is a general lack of empirical research that considers whether social success (e.g. knowledge sharing) is associated with, or leads to environmental success (e.g. improvements in habitat condition). Section 5 helps fill that gap, providing a summary of one of these project’s

articles, Limenih et al. (in review), which analyses data from the on-line survey described in Section 4, about people's perceptions of various types of success (26 different ecological, social and economic outcomes, and a measure of whether each activity was perceived as having achieved its primary objective). This work moves discussions beyond those that consider a relatively narrow set of outcomes, to one that considers the inter-relationships between diverse outcomes in a complex integrated system.

- 6) A substantial body of literature highlights that numerous different factors contribute to success, however, with a few notable exceptions (Engert and Laurance, 2023, Commonwealth of Australia, 1997, Bottrill et al., 2011) most of this work is somewhat compartmentalised in that it has focused on just one or 2 groups, or just a few groups within a single region and most has focused on either social or ecological issues, not both (Limenih et al., 2026). As such, relatively little is known about the factors that contribute to success in complex, connected, social-ecological systems. Section 7. helps fill that knowledge gap, briefly summarising one of project's journal articles, (Limenih et al., in prep). It uses a variety of different statistical approaches to analyse data from the on-line survey described in Section 4, identifying which, of numerous diverse factors (including characteristics of participants, access to supporting resources, experiences and unexpected ecological, social or economic events) have greatest influence on people's perceptions of different types of success (outcomes). In doing so, this paper pushes knowledge boundaries by identifying different predictors of success in complex and connected systems.
- 7) Sustained engagement by a diverse range of experienced practitioners (including professionals, volunteers, and land managers) is critical for achieving conservation outcomes which typically take years (or even decades) to emerge, yet most prior research has focused on initial motivations or specific participant groups or on motivations to engage in a single type of activity. As such, the factors that drive continued participation in diverse activities undertaken within a connected and complex system remain poorly understood. Section 8 helps fill that knowledge gap, providing a summary of one of these project's articles, Larson et al. (in review), which analyses data from the on-line survey in conjunction with data collected by researchers associated with RL Hub Projects 1.4 and 2.3, to determine which factors most strongly predict people's desire to remain engaged in NRM activities into the future. This paper thus helps move conversations beyond those that consider how to encourage specific groups of people to participate in NRM activities for the first time, into one that considers ways of sustaining the engagement of diverse contributors for the long term, in complex and connected systems.

2 Establishing the importance – and difficulty – of demonstrating success

This section of the report summarises and paraphrases sections of a published open-access paper, Stoeckl et al. (2025), available at <https://www.sciencedirect.com/science/article/pii/S1470160X25004261>

Noted in Section 1, public and private funders often require that NRM projects and activities, demonstrate success, or at least demonstrate that proposed activities have a good chance of ‘success’. We argue that by finding better ways to highlight the success (or ‘value’) of NRM projects and activities it may be possible to improve information flows, helping designers to plan for, and funders to identify and prioritise the most beneficial projects (Kragt et al., 2017, Amato and Petit, 2023, Romsdahl et al., 2015). This may have the effect of ensuring that scarce resources are directed towards the most promising NRM activities.

In this paper we highlight the need for, and some of the challenges of, measuring the success (or ‘value’) of nature-focused projects/activities, particularly in highly connected systems

There is, however, an important caveat: assessments must consider an extremely diverse array of outcomes associated with activities. If assessments only focus on a subset of outcomes (e.g., only agricultural benefits, or only the preservation of a single species), investments may be directed towards projects that generate a narrow range of easily measured benefits, rather than towards projects that generate the most benefits. This accords with calls to move practices which have historically focused on, for example, protected areas, and/or individual species to instead consider conservation and restoration actions in multifunctional connected “scapes” (Pörtner et al., 2023).

That said, we note that there are numerous challenges to address if wishing to comprehensively assess the benefits or ‘value’ of NRM (and other nature focused projects), particularly those that generate diverse benefits at large scale, or that create change in highly connected systems. In an ideal world, one might want to develop highly sophisticated coupled systems models, populated with extensive amounts of high-quality data and information about interactions between variables, to properly assess outcomes. But we do not live in an ideal world and do not currently have the data, information and knowledge to build such models. This leaves us with the choice of either (a) doing nothing until better information is available (which risks people entirely overlooking some complex values), or (b) using models that may not be ideal, but are at least, better than nothing since there are circumstances when having “even an inaccurate estimate of [a non-market] value can be more valuable to decision-makers than no number” (Pannell et al., 2025). Not wanting to ‘do nothing’ while waiting to develop a perfect model, our subsequent work sets out to improve understandings of ‘success’, and factors that drive the ‘success’, of NRM activities in complex, highly connected systems.

3 Understanding what is (and is not) already known about success

This section of the report summarises and paraphrases sections of a published open-access paper (Limenih et al., 2026), available at <https://doi.org/10.1016/j.biocon.2025.111630>

We conducted a systematic literature search to identify studies that sought to reveal or measure factors influencing the outcome of various NRM initiatives. We focused on initiatives that involved a blend of formally constituted programs, informed by scientists, managed by various organisations, and implemented by practitioners and volunteers – thus with similar characteristics to the initiatives undertaken by Australian practitioners associated with the NLN, NRM Regions Australia, and the DCEEW threatened species recovery teams.

We found two parallel, albeit somewhat disconnected strands of research: namely socioeconomic and ecological/biophysical investigations. Many studies have considered the influence that social factors have on either social outcomes or on natural resource management initiatives and many studies have considered the influence that natural resource management initiatives and ecological factors, have on ecological outcomes, but there is a dearth of research that considers the influence of social factors on ecological outcomes. For example, social scientists have identified factors that contribute to, or detract from, the popularity of Australia’s community Landcare movement (Ross et al., 2009, Measham et al., 2011), including the important roles of social capital (Graham and Rogers, 2017) in driving participation rates. But much of this work has implicitly assumed that success is synonymous with high participation rates, and relatively little research has sought to assess the extent to which high participation rates and/or improvements in social capital generate measurable ecological improvements (Primack et al., 2021). Similarly, numerous scientific experiments have been undertaken to identify biophysical factors that contribute to success (White et al., 2021, Stegner et al., 2017, Heise-Pavlov, 2019), but these biophysical studies rarely consider the social context in which activities take place.

We blended insights across diverse literatures, to develop a conceptual model that highlights a potential pathway from social to ecological success

Whilst the separation of biophysical and socio-economic investigations prevented us from undertaking a quantitative meta-analysis, by qualitatively blending insights from those bodies of work, we were able to identify a likely pathway from socioeconomic drivers to ecological successes (Figure 4, Limenih et al. (2026)). This pathway highlights that simply having the right social conditions, access to resources and access to diverse people with diverse skills who are willing and able help protect the environment, is not in itself enough: people need to know what physical changes are necessary to create genuine and lasting change. There must also be on-going and committed institutions, people and resources to manage, implement, sustain, and maintain, the necessary changes. The pathway also highlights that even when it is possible to combine the ‘will of the people’ with biophysical know-how and ongoing socio-institutional

support, unexpected events can affect final outcomes. These 'events' include, but are not limited to, the impacts of climate change: many other external events that impact outcomes have been identified in the literature and relate to social factors, such as changes or uncertainty in government policy, the erosion of institutions, and changes in the economy that create financial uncertainties.

One can thus conceptualise the environmental changes that result from NRM activities as a journey along a 'pathway': effectively mobilising people, to undertake actions that effect change, while also acknowledging the probable existence of feedback loops where changes that occur along the path feed-back to, and thus influence other steps. For instance, when natural resource management activities change peoples' attitudes / perceptions, this will influence the context in which future initiatives occur and will thus have a bearing on future ecological outcomes.

The pathway thus provides messages similar to messages provided elsewhere in the literature: namely that positive environmental change, requires one to understand both biophysical systems and processes (e.g., knowing what physical changes need to occur) and socioeconomic systems and processes, encouraging and supporting people and organisations to undertake appropriate change for sustained long-term improvements.

4 Collecting data for comprehensive assessments

With a few notable exceptions (Engert and Laurance, 2023, Commonwealth of Australia, 1997, Bottrill et al., 2011) most assessments of the NRM activities have focused on just one or 2 groups, groups within a single region, or groups within a single state, with little to no cross-group, cross-region integrative assessments. At least part of the reason for this relates to the fact that some data collection protocols (e.g. those undertaken by individual researchers or research groups) have historically evolved from the ‘ground up’. In recent decades the Australian Government has required that data be collected in specific ways if seeking funding, but these requirements are not always consistent with State funding or other funder requirements. As such, different groups have tended to collect information about different things, in different ways, and at different times. So whilst it has been possible to “identify many pixels of best practice in policy, incentives, planning, regulation and on-ground practice” (Campbell et al. (2017), p 405), the mis-matching of variables and datasets across sites hampers efforts to compare the impact of different activities undertaken in different areas – particularly if aiming to control for numerous potentially confounding factors (Duncan and Reich, 2016, Bottrill et al., 2011). This has made it all but impossible to aggregate data to get a ‘bigger picture’ (Hansen et al., 2019), to learn more about what works best in which contexts, to demonstrate the success of projects and programs, or to design for success.

We used insights from our partners and the broader literature to develop a conceptual model of ‘success’ (Figure 1) and then used that model to guide the collection of data and subsequent analyses.

4.1 Data - overview

We set out to collect and collate data that could be used to populate our conceptual model of ‘success’ (Figure 1), so that we could learn more about the ‘success’ of a diverse array of NRM focused activities, and the factors affecting ‘success’, in a complex social-ecological system. This was done in two related activities:

- 1) Working in partnership with the National Landcare Network (NLN), the Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW), NRM Regions Australia, NSW DCCEEW and Greening Australia, we co-designed an on-line survey (Appendix A) that could be used to collect data to populate variables that are loosely described in Figure 1, specifically those circled in red.
- 2) Also partnering with researchers in RL NESP Project 1.4 (Socioeconomic insights for resilient landscapes), we rescaled data that had been collected through that project and which had been updated through RL NESP Project 2.3 (Using integrated data analysis to assess regional transferability), to describe postcodes. From that larger dataset (available at: <https://rdp.utas.edu.au/metadata/2b8b74f9-5767-473a-89d0-347c40a1600d>), we selected a subset of cases corresponding to postcodes represented in our survey, so that we could

describe the social-ecological context in which the various activities were operating in (purple segment, Figure 1). This 'contextual' information was used in conjunction with survey data in the analysis described in Section 8.

Further details are provided in the subsections below.

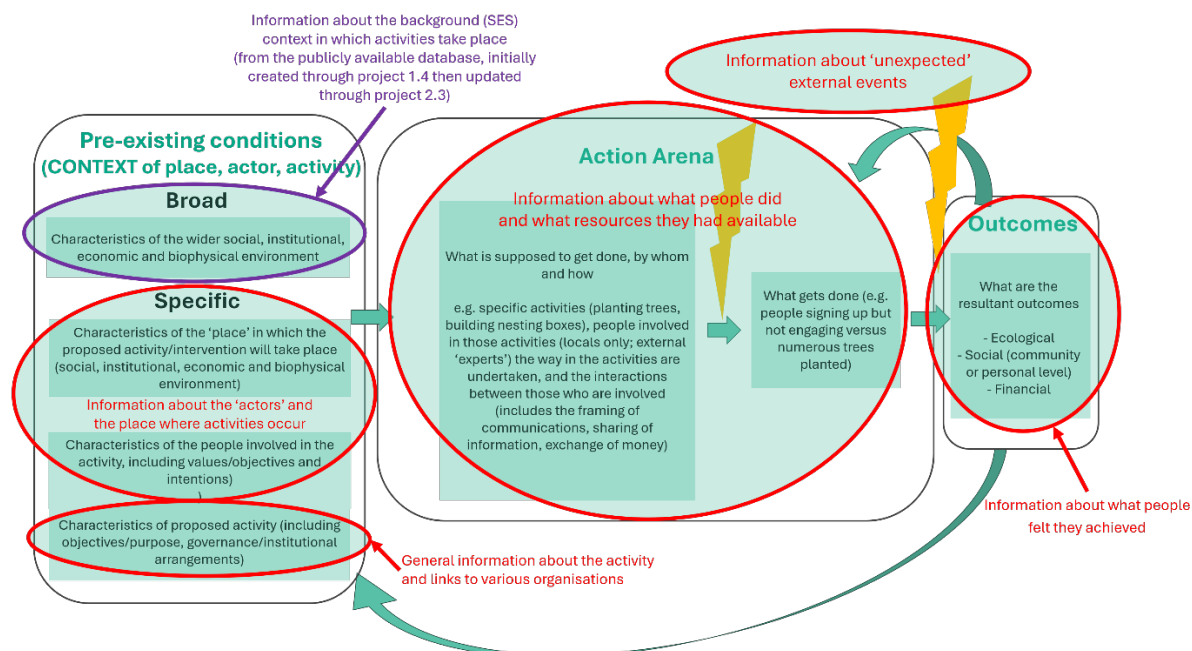


Figure 1: Conceptual model used to guide the collection of data and subsequent analysis.

On-line data collection

The on-line survey was distributed between February and August 2025, targeting people who owned, managed, or were involved in decision-making for a property that participated in NRM activities, or who participated in NRM activities independently or through associated groups. Our target group thus included a wide diversity of people, such as land managers, community volunteers, coordinators, managers and expert advisors. It was distributed through our partner networks (National Landcare Network; NRM Regions Australia; Department of Climate Change, Energy, the Environment and Water; NSW DCEEW and Greening Australia, and the RL Hub of NESP) using email invitation and social media outreach. Participation was voluntary and informed consent was obtained prior to survey completion. Respondents were assured of confidentiality and anonymity. The study protocol was reviewed and approved by the University of Tasmania Ethics Committee (reference code -H-107097).

Overview of on-line survey responses

We received 244 completed surveys – although not all respondents answered all questions, so the analyses reported on in subsequent chapters have slightly different sized samples (depending on missing data for specific variables). We explored options to provide summary data at the postcode level, but there were too few observations within each individual postcode for us to ensure complete confidentiality of respondents (the ABS, for example, will not release small area data, if there are a small number of respondents). We also explored options for releasing data at larger geographic scale, specifically for NRM Regions. However, although respondents reported

on activities undertaken across 47 different regions, the number of observations per NRM region was too small to be able to guarantee confidentiality if releasing summaries even at that larger scale. So, in this section of the report, we provide a general overview of the respondents and the activities they had been involved in.

This background information is important because the participation in the survey was voluntary, so one cannot assume that the views of respondents represent the views of all people involved in Australian Landcare or NRM activities. We describe where respondents lived, what their socioeconomic background was, what types of NRM activities they have had experience with, and which specific types of activities they chose to provide more detailed information on. Most notably, we find that our sample is dominated by people who have been involved in many different NRM activities, over many years, in a variety of different 'roles' – e.g., as landowners, land managers, volunteers, coordinators (both paid and volunteer), expert advisor, project/department managers, and fund managers.

The length, depth, and breadth of the experience of our respondents positions our sample well to provide information to improve our understanding of factors that support, or inhibit, long term 'success' of NRM activities – but our data provides no insights or information about people who have never engaged, or who have chosen to disengage. Moreover only 8 respondents identified as being of Aboriginal or Torres Strait Islander descent. Our data cannot and should not be used to draw any conclusions about First Nations definitions of success or Caring for Country and the 48 activities that people describe as having some sort of link or association with Aboriginal or Torres Strait lander groups should not be treated as providing First Nations evidence – research that seeks to identify 'success' in that context would need to be led by the relevant Traditional Owners and First Nations organisations.

4.1.1 Respondent roles and geographic location

Almost one half (49%) of respondents were land managers or owners and they were located across the country with the spatial distribution largely reflecting population densities, in that there were a greater number of respondents along the southeastern seaboard than in the northwest and central regions. Respondents were drawn from a variety of biomes, with participants having been engaged in NRM activities in temperate broadleaf and mixed forest regions, tropical and subtropical grasslands, savannas and shrublands (Figure 2).

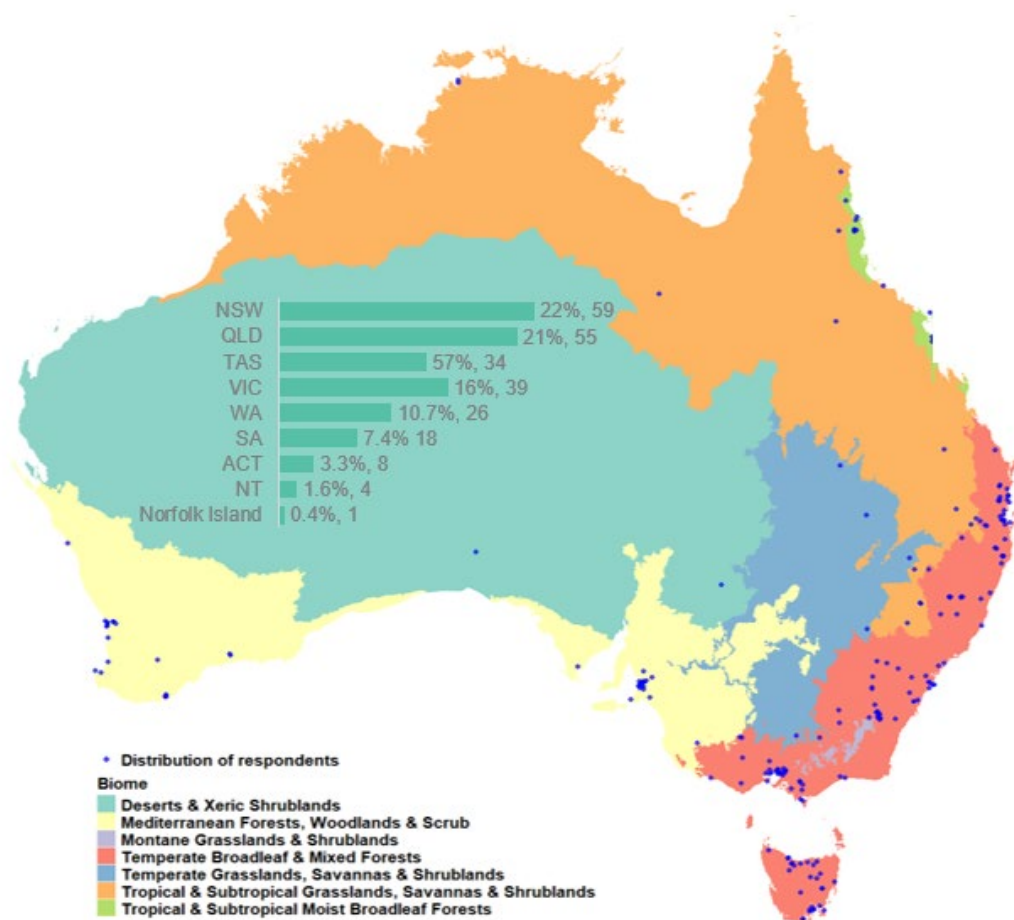


Figure adapted from Fig XXX, Limenih et al. (in review).

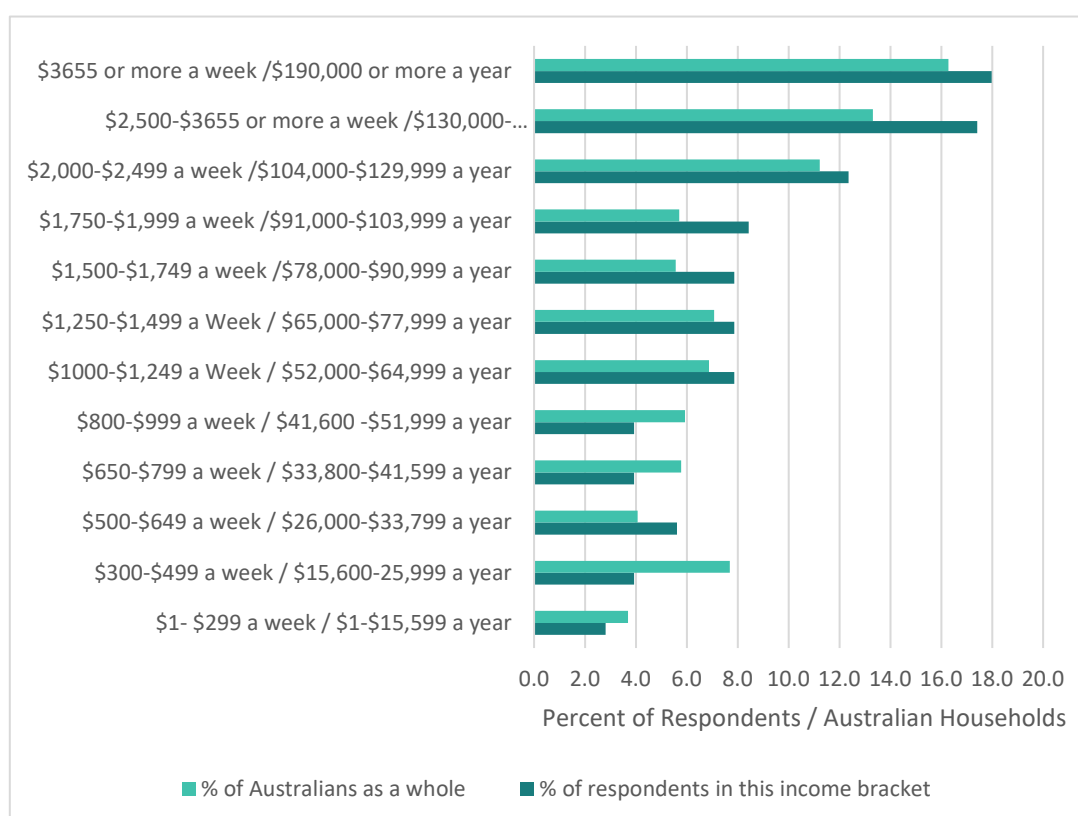
Figure 2: Spatial distribution of respondents, using postcode centroids, overlaid on the World Wildlife Fund (WWF) classification to ecoregions (Dinerstein et al., 2017).

4.1.2 Sociodemographic background of respondents

The average age of our respondents was 56.7 years, about 55% were female; 76% had a university degree; only a few were of Aboriginal and/or Torres Strait Islander descent (Table 1). The household income of our respondents was generally higher than the household income of all Australians (Figure 3).

Table 1: Socio-demographic overview of respondents.

	Characteristic	Count
Highest level of education completed	Year 9 or below	2
	Year 10	6
	Year 11	0
	Year 12	3
	Certificate (I/II)	2
	Diploma or Certificate (III or IV)	28
	Undergraduate University Degree (e.g. BSc, BA)	98
	Postgraduate University Degree (e.g. MSc, Ph.D.)	76
Gender	Male	96
	Female	124
	Non-binary	1
	Prefer not to answer	4
	Other (please specify)	0
Aboriginal &/or Torres Strait Islander origin status	Yes	8
	No	209
	Prefer not to answer	7



Australian data sourced from: <https://www.abs.gov.au/census/guide-census-data/census-dictionary/2021/variables-topic/income-and-work/total-household-income-weekly-hind>

Figure 3: Household Income of respondents compared to all Australian Households.

4.1.3 Activities that the respondents had been involved in

Our respondents had a breadth and depth of experience, with most having been involved in a large number of different activities over the years, many of which they deemed to have been ‘successful’ (Figure 4).

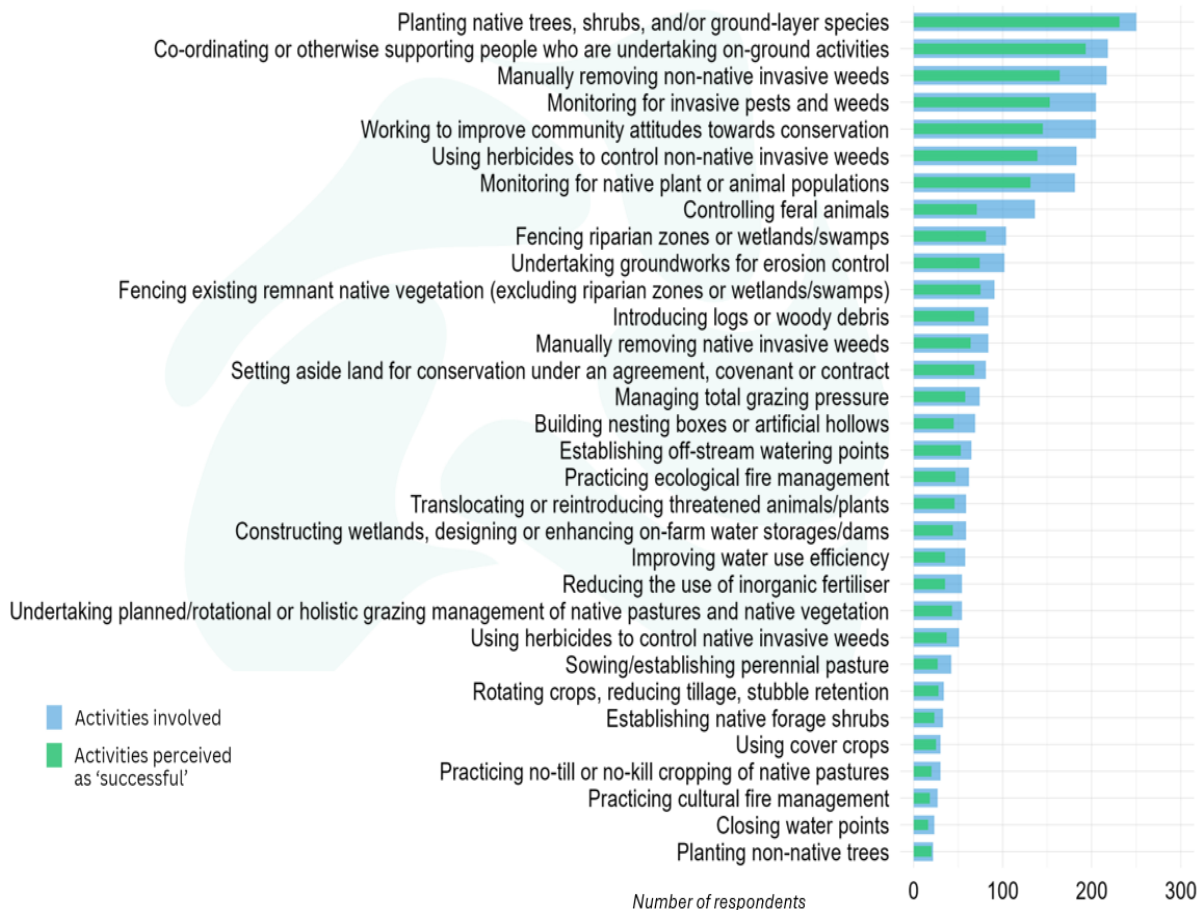


Figure 4: The number of different activities that respondents had been involved in over the years (blue bars), and those that were perceived as having been ‘successful’ (green bars).

4.1.4 Specific activities that the respondents provided more detail on

We asked respondents to focus on just one of the activities that they had previously, or were currently, involved in with the rest of the on-line survey asking for more detailed information about that particular activity. The most frequently selected activities (and thus, those we know most about) were: Planting native trees, shrubs and/or ground layer species; co-ordinating or otherwise supporting people who were doing on-ground work; working to improve community attitudes towards NRM activities; manually removing non-native invasive weeds and monitoring for native plant and animal populations (Figure 5).



Figure 5: The activities chosen by respondents – about which they provided additional information.

Almost 50% of those activities (N=99) had commenced in 2016 or earlier (Figure 6) and most (N=201) were on-going. About one-half of all activities had been undertaken on private property (Table 2). Some activities (N=44) involved multiple locations although most of the non-private property activities (N=71), were undertaken at just one site. When involved in these activities, respondents played a variety of different ‘roles’ (e.g., community volunteers, coordinators, expert advisors) with many indicating that they played more than one role. Only about one-quarter of activities were undertaken independently; the majority of activities (N=163) were linked to, or associated with at least one regional, state or local government program; many were also associated with national programs (59), and/or Aboriginal or Torres Strait Islander programs (48); 73 activities were linked to or associated with more than one of these broad groups (e.g., national and regional).

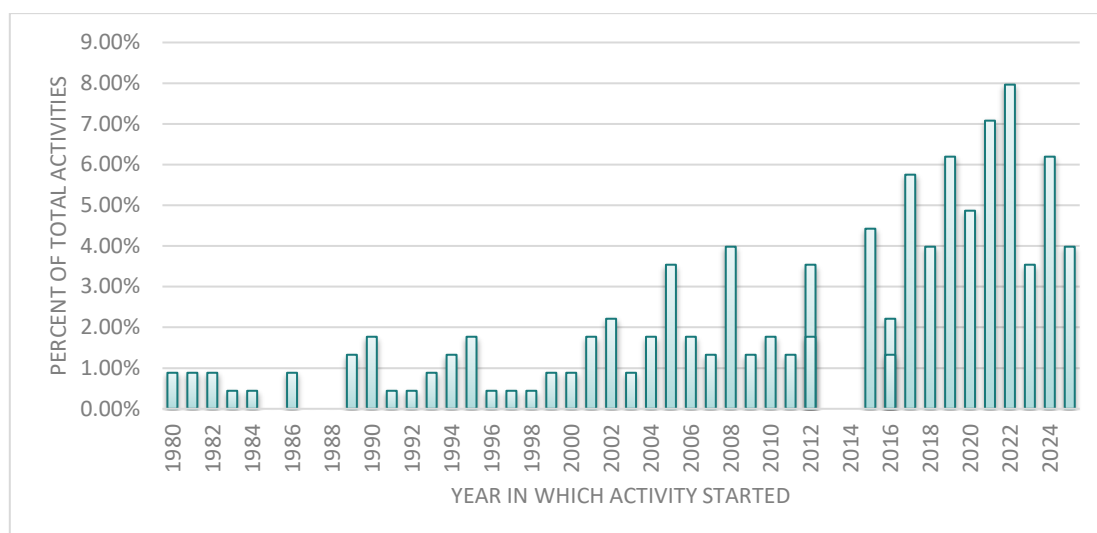


Figure 6: The year in which chosen activities commenced.

Table 2: Selected characteristics of the chosen activities.

Characteristic of Activity		N
Partnerships / Links with various NRM organisations or programs	An Aboriginal or Torres Strait Islander group or program	48
	A national group or program	59
	A regional, state, or local group or program	163
(not mutually exclusive)	Independent (i.e. no association with any formal groups)	60
Role of respondent while engaged in this activity	Community member or volunteer	74
	Coordinator or facilitator (volunteer)	64
	Coordinator or facilitator (paid)	52
	Expert advisor	47
	Project/department manager	37
	Fund manager	17
	Other	34
Other Locational details	Undertaken on Private property	113
	Not undertaken on private property	115
	Mostly in one area / region	71
	Involving multiple areas regions (e.g., for migratory species)	44

We asked respondents to tell us about the primary objective of their chosen activity, in an open-ended question and coded responses into five (non-mutually exclusive) groups, identified from our exploratory factor analysis (see section 5 for more detail). Most activities had a primary objective that was focused on habitat, or ecological condition (70%); many also focused on threatened species (29%), some (22%) had broader institutional objectives; 11% included economic or other on-farm objectives, with just a handful (2%) focused on individual objectives, e.g., health and wellbeing. Most

activities were deemed to have come very close to achieving their primary objective (being allocated 4, out of a maximum of 5, on a Likert scale, Figure 7).

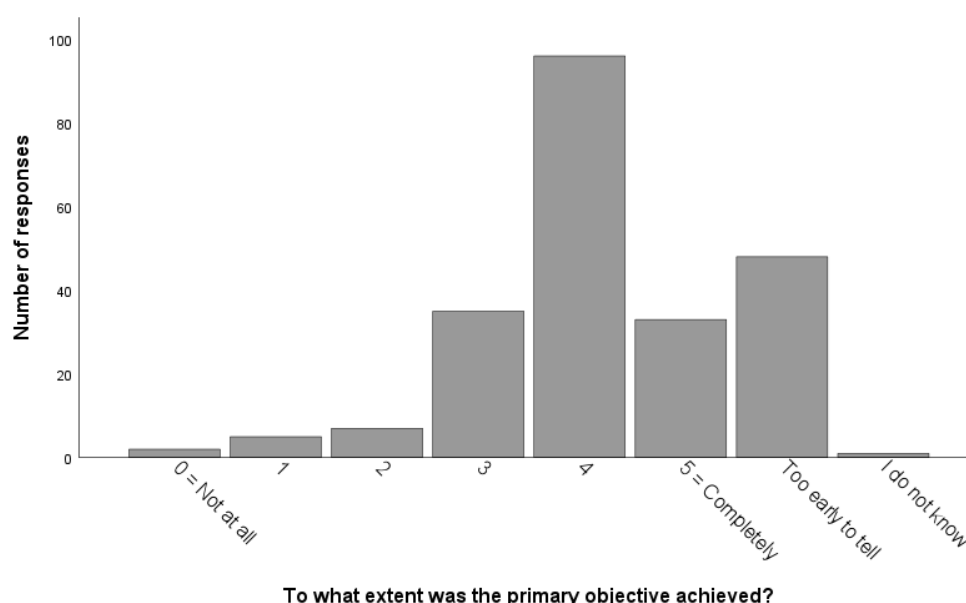


Figure 7: Respondent perceptions of the extent to which chosen activities had achieved primary objective.

4.1.5 Social and economic enablers available to respondents

Amongst other things, we asked respondents to tell us about the availability of various social and economic enablers, with most people indicating that social enablers (like having ‘evidence that actions work’, and supportive friends, family and communities) were widely available; economic enablers – particularly those linked to compensation payments and/or financial incentives were perceived as being much less readily available (Figure 8).

Which of the following factors were available to support your activities?

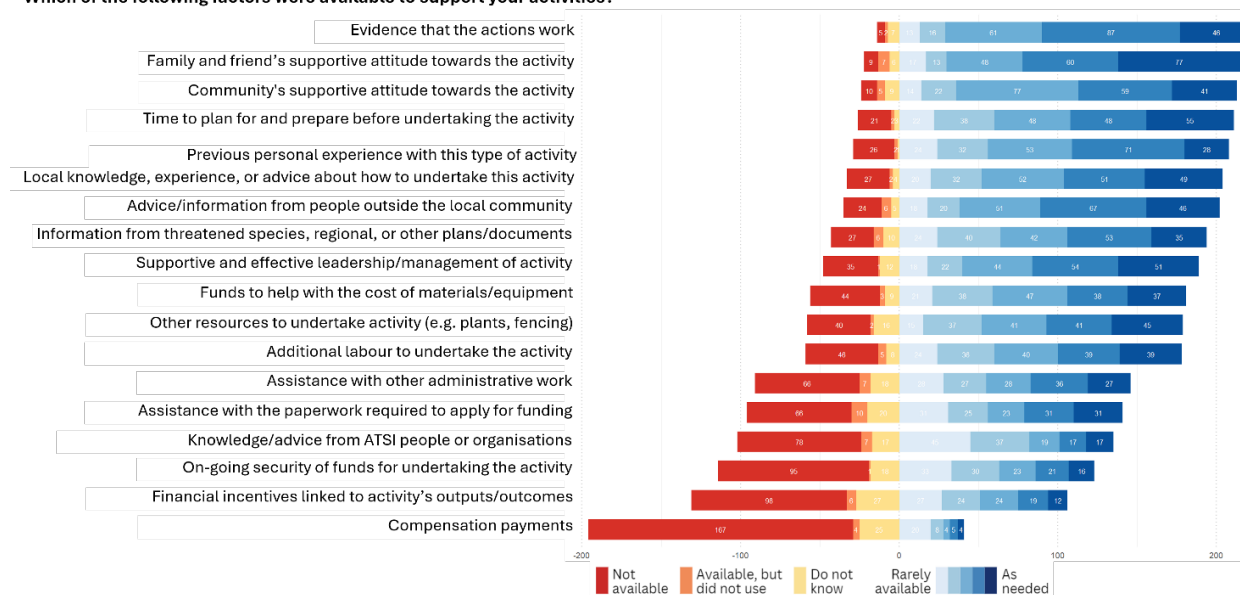


Figure 8: The availability of social and economic ‘enablers’ to support chosen activities.

4.1.6 Unexpected environmental, social and economic ‘events’ impacting activities

We also asked respondents to tell us whether any unexpected social, economic and environmental ‘events’ had helped or hindered outcomes. Most people indicated that that their activities had been negatively impacted by environmental ‘events’ – most notably, invasive weeds, extreme temperatures, and droughts; but unexpected social changes, including things like ‘life events’, COVID-19 and changes to NRM-related government policies were also often reported as being disruptive (Figure 9) – potentially more disruptive than floods, cyclones and wildfires.

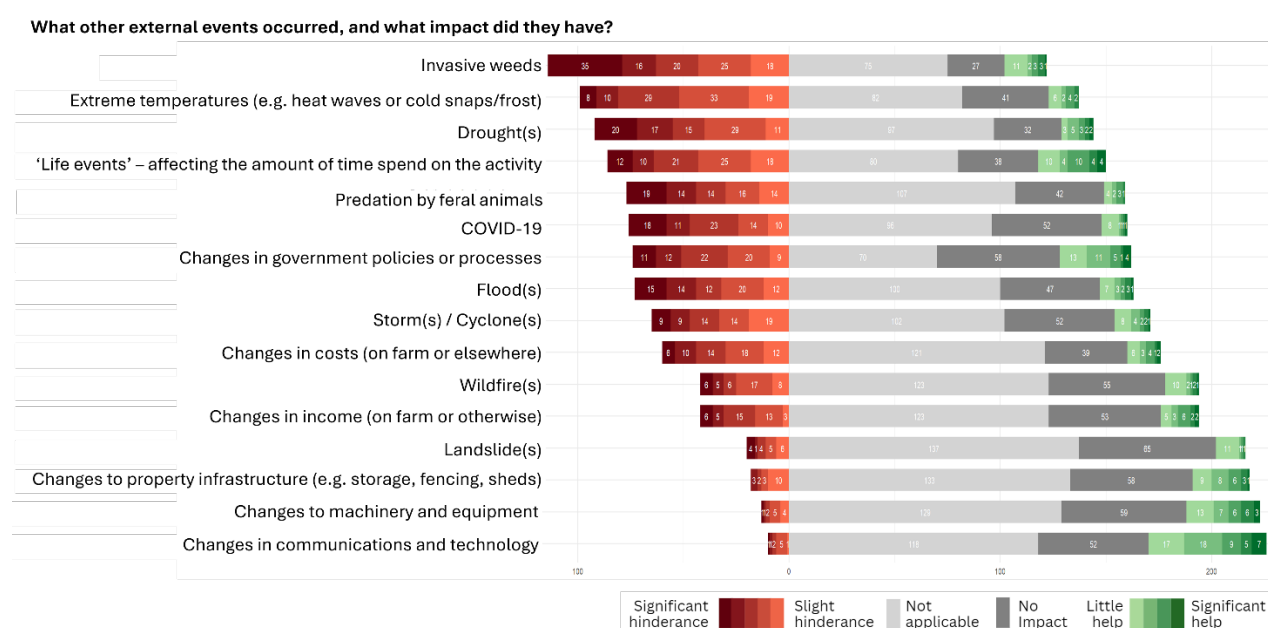


Figure 9: The impact of ‘unexpected’ social, economic and environmental ‘events’ on chosen activities

The social-ecological context in which activities took place

Partnering with researchers in RL NESP Project 1.4 (Socioeconomic insights for resilient landscapes), we rescaled data that had been collected through that project (and which was updated through RL NESP Project 2.3 - Using integrated data analysis to assess regional transferability), to describe postcodes. That postcode level dataset is available at: <https://rdp.utas.edu.au/metadata/2b8b74f9-5767-473a-89d0-347c40a1600d>.

From that published dataset, we selected a subset of cases corresponding to postcodes represented in our survey, so that we could describe and characterise the social-ecological context in which the various activities were operating in (purple segment, Figure 1). Data gaps (in the contextual dataset), meant that we were only able to match 194 postcodes. For single site activities, we used the postcodes for the location where the activity took place; for multiple site activities we used the respondents’ residential postcode. The results that are presented in Sections 7 & 8, thus need to be interpreted knowing that the contextual data is likely better matched to single-site activities than to multi-site activities (certainly for ecological variables).

Having selected this subset of data, we divided variables into three groups: those describing the ecological system, those describing the social system and those describing interactions between the two systems. We removed duplicate or highly correlated variables; continuous variables were tested for skewness and transformed if highly skewed. Some groups of variables were converted into factors (e.g., there were 32 different variables describing the % of total area for each major vegetation type which we transformed into a single variable describing the dominant vegetation type within each postcode).

When characterising postcodes, we used k-prototype clustering, which is appropriate for mixed data sets, to identify postcodes sharing 'similar' contexts, finding four clusters for each subset of data. We used both eta squared and Cramer's V statistics to identify variables having the strongest influence on cluster membership and focused on those 'strong' variables when describing the groups (clusters) of postcodes. More methodological details are provided in the supplementary materials of Larson et al. (in review); Table 3 provides an overview of the characteristics of each 'cluster' of postcodes.

Table 3: Characteristics of each of four clusters identified when using the ecological dataset, the social dataset and the interactive dataset. Note that any given postcode may belong to a different cluster for each dataset (e.g. it may be categorised within cluster 1 when using ecological data, cluster 4 when using social data, and cluster 3 when using interactive data).

Four different ecological clusters (based on ten most influential variables)			
<u>Intact – 1:</u> Most intact systems, with high plant and species richness, relatively warm with high rainfall	<u>Intact – 2:</u> Relatively intact systems, with high EPBC species and ecological community richness, some plant species richness, and relatively high rainfall.	<u>Intact – 3:</u> Poor habitat condition, with relatively low plant, EPBC species and ecological community richness	<u>Intact – 4:</u> Least intact systems, with poor habitat condition, low plant, EPBC species and ecological community richness, driest
Four different social clusters (based on ten most influential variables)			
1. <u>Urban</u> , and the most affluent, with the highest average income, a high proportion of people having degrees, and high levels of employment	2. <u>Outer urban</u> , relatively affluent, with a relatively high proportion of people with degrees, high level of employment	3. <u>Regional</u> , relatively low incomes, not particularly affluent, relatively low proportion of people with degrees, relatively low rates of employment, relatively large number of women with > 3 children	4. <u>Rural</u> /remote, not affluent, few people with degrees, large number of women with > 3 children, large proportion of workforce in agriculture, forestry and fisheries
Four different interactive clusters (based on five most influential variables)			
<u>Ag&Cons:</u> Dominant land uses are agriculture and conservation	<u>Ag&Fors:</u> Dominant land uses are agriculture and forestry	<u>Res:</u> Dominant land uses are residential, and related (e.g., services)	<u>Semi-Rural.</u> Dominant land uses are semi-rural farming

5 Understanding how diverse actors work together within a shared NRM system

This section of the report summarises and paraphrases sections of Tsai et al. (in review).

Most of the socioeconomic research that considers NRM focuses on a single stakeholder group (e.g. farmers, volunteers; Greiner, 2015, Measham and Barnett, 2008), or on a particular initiative, organisation, or location, and tends to examine implementation outcomes rather than the broader system structure (Bennett, 2016). One reason for this may be that many NRM actors occupy multiple roles (Crona and Bodin, 2006, Reed et al., 2009), which blurs the boundaries of responsibility and adds complexity to stakeholder analysis. These complexities have prompted increasing attention to how stakeholders are categorised, given that participatory planning requires clarity about who holds influence, who has stakes in the issue, and who may be affected by an intervention (Franco-Trigo et al., 2020). However, there remains limited empirical understanding of how diverse actors cluster within a shared NRM system, what kinds of initiatives they participate in, for what reasons, and how those participation patterns reflect the complementary roles required to create and sustain resilient ecological systems.

We analysed the survey data to improve our understanding of how diverse actors work together within a shared NRM system – and what motivates them to do so.

First, we used principal axis factoring to identify shared objectives (respondents had been asked to indicate, on a Likert scale, how important each of 26 different objectives were), finding 5 statistically distinguishable groups (Figure 10). We then used two-step clustering to divide our respondents into four groups of ‘actors’, based on their role in the NRM activity (institutional professionals (which includes paid coordinators, expert advisors, and fund managers), volunteer coordinators, community volunteers, private land holders) and their motivations. We note these are sample-derived clusters, not fixed categories or a hierarchy of value. Each of the four groups of actors were primarily motivated by environmental objectives (e.g., improving the ecological condition of land, or species protection and recovery); other social and economic motivators/objectives existed, but there were somewhat divergent views about their importance across actor groups (Figure 11).

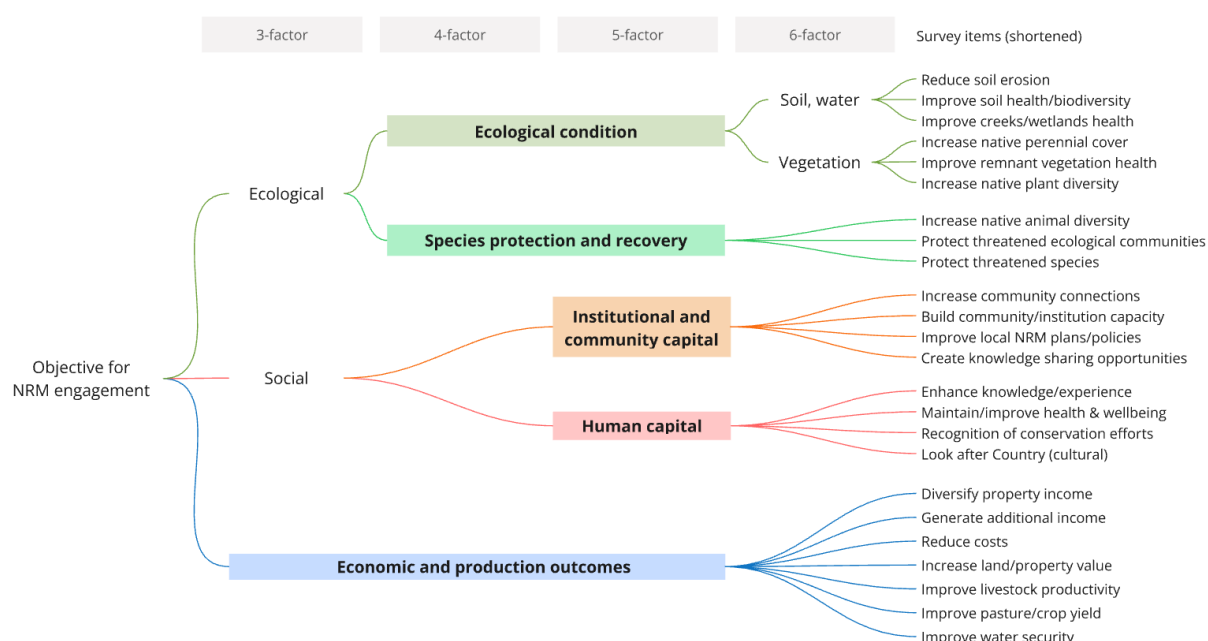


Figure adapted from findings (Tsai et al., in review).

Figure 10: Determining which ecological, social and economic objectives group together.

Actor group	Defining characteristics	Shared ecological priorities (mean score, 0–5 scale)	Other priorities comparatively higher (mean score, 0–5 scale)
Independent landholders (n = 36)	100% property owners 33.3% property managers	Ecological condition: 3.51 Species protection and recovery: 3.24	Economic and production outcomes: 1.68
Community volunteers (n = 45)	100% community members or volunteers 44.4% property owners	Ecological condition: 3.09 Species protection and recovery: 3.67	Human capital: 2.68 Institutional and community capital: 2.84
Volunteer coordinators (n = 65)	100% volunteer coordinators 47.7% community members or volunteers	Ecological condition: 3.22 Species protection and recovery: 3.39	Institutional and community capital: 3.28
Institutional professionals (n = 98)	45.9% paid coordinators 34.7% project managers 30.6% expert advisers	Ecological condition: 2.53 Species protection and recovery: 3.27	Institutional and community capital: 3.01

Adapted from Table 2. Characteristics of actor groups identified through cluster analysis (Tsai et al., in review). Full results and statistical comparison groupings are reported in the manuscript.

Figure 11: Characteristics of groups of actors in the shared NRM system.

In addition to asking respondents to tell us about the importance of each of the 25 potential objectives listed in (Figure 10), we also asked them to tell us about the primary objective of their chosen activity, in an open-ended question. We coded responses to indicate which of the five categories identified from our exploratory factor analysis best described that primary objective. We then used latent class modelling to divide the various activities that respondents had provided information about their objective? into four broad categories, based upon where the activity was taking place (private versus public land, single or multiple site), which types of organisations the

activity was linked to (none for some private land holders, various local regional and national organisations), and the (coded) primary objective of the activity (Figure 12).

Classes (Activity types)	Program affiliation profile	Location or property profile	Focus of primary objective				
			Ecological condition	Species protection and recovery	Institutional and community capital	Human capital	Economic and production
Multisite activities focused on habitat condition (n = 57)	Indigenous: 11.0% National: 16.4% Regional: 63.0% Independent: 9.6%	Multiple locations: 100.0% Private property: 0%	73.4%	18.8%	1.6%	0%	6.3%
Regional stewardship activities (n = 110)	Indigenous: 15.1% National: 21.1% Regional: 59.6% Independent: 4.2%	Multiple locations: 0% Private property: 69.1%	57.1%	17.0%	12.9%	0.7%	12.2%
Private-land activities (n = 45)	Indigenous: 0% National: 0% Regional: 11.8% Independent: 88.2%	Multiple locations: 0% Private property: 97.8%	66.7%	24.6%	0%	0%	8.8%
Institutional and community engagement activities (n = 32)	Indigenous: 28.1% National: 23.4% Regional: 42.2% Independent: 6.3%	Multiple locations: 50.0% Private property: 0%	12.2%	8.2%	65.3%	14.3%	0%

Figure adapted from Table 3. Characteristics of activity types identified through LCA, (Tsai et al., in review).

Figure 12: Characteristics of groups of activities that respondents had been involved in

Finally, we considered how the participation of actors differed systematically across different types of activity. We found that the differences did not reflect differences in priorities, but rather differences in their roles and responsibilities, land ownership, and the scale and context of the initiatives they were involved in (Figure 13). These patterns reflect the inherently multi-level nature of NRM, in which environmental outcomes emerge through interactions among actors operating at property, community, regional, and institutional levels (Han et al., 2024, Hamilton et al., 2021). Regional NRM priorities are articulated in regional NRM plans linking to federal and state government, and community priorities. Many groups (including, but not limited to, Indigenous groups, researchers, and diverse community groups) contribute to those plans by identifying priorities, contributing local knowledge and thereby influencing regional and national agendas. All of these groups, including regional NRM organisations, design and implement projects. While this interdependence is well recognised in environmental governance scholarship (Newig et al., 2018, Bodin and Crona, 2009), this study shows empirically how complementary roles are channelled through different activities/initiatives within a shared NRM system. This helps move discussion beyond treating actor groups as separate stakeholder categories and towards understanding how their contributions collectively support ecological gains across scales.

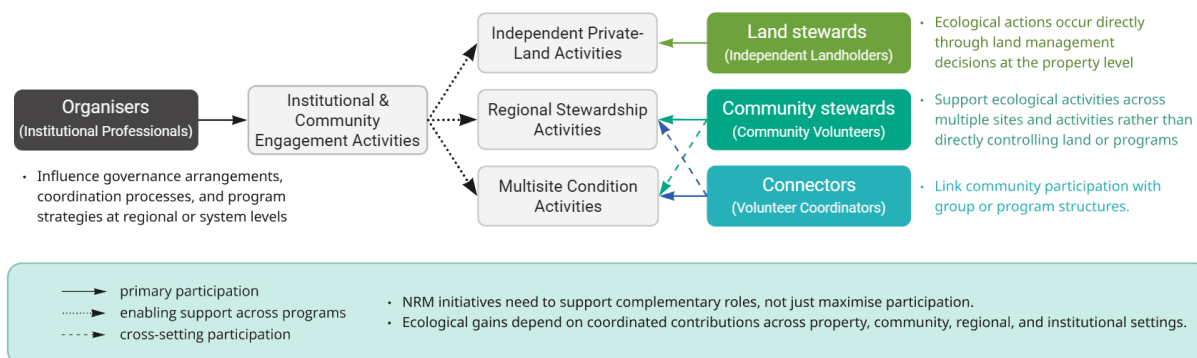


Figure adapted from Figure 2. Empirically grounded conceptual model of complementary functional roles in multi-level NRM systems, (Tsai et al., in review).

Figure 13: Conceptual model showing how diverse actors work together to generate positive conservation outcomes in a complex system.

6 Understanding multidimensional success

This section of the report summarises and paraphrases sections of Limenih et al. (in review).

Much previous social research has implicitly assumed that ecological success is synonymous with high participation rates and has demonstrated the important role that programs such as Landcare play in building different types of social capital – particularly bonding and bridging (Mitchell and Allan, 2019). The on-farm economic impacts of Landcare have been estimated (Natural Decisions Pty Ltd, 2015) and some researchers have sought to determine the extent to which, participation in Landcare and/or recovery teams, associated changes in social capital (Campbell and Siepen, 1994, Curtis et al., 2000) and/or strong leadership (Black et al., 2011) have led to positive environmental change. Case studies suggest that positive social change may lead to environmental benefits, but the aforementioned siloing of socioeconomic and biophysical research (Limenih et al., 2026) means that there is a general lack of national-scale, empirical research, or data, that allows one to assess the relationship between different types of social, economic and/or ecological successes.

We analysed the survey data to explore the multidimensional nature of success, checking for evidence that social success is associated with or leads to environmental success and checking whether respondents felt confident assessing different types of success.

As discussed in Section 4.3.4 we asked respondents to tell us about the extent to which they felt they had achieved their activity's overall objective – giving us a (subjectively measured) indicator of 'success' (see Figure 7). We also asked them to tell us about the extent to which they felt they had achieved each of 26 different ecological, social and economic objectives (Figure 14). We used that data to examine four interconnected aspects of perceived NRM success, determining: (1) whether trade-offs or synergies exist among success indicators, (2) the relative contribution of different outcome domains to overall perceived success, (3) which outcomes are difficult for stakeholders to observe or self-assess, and (4) which require extended timeframes before meaningful evaluation is possible.

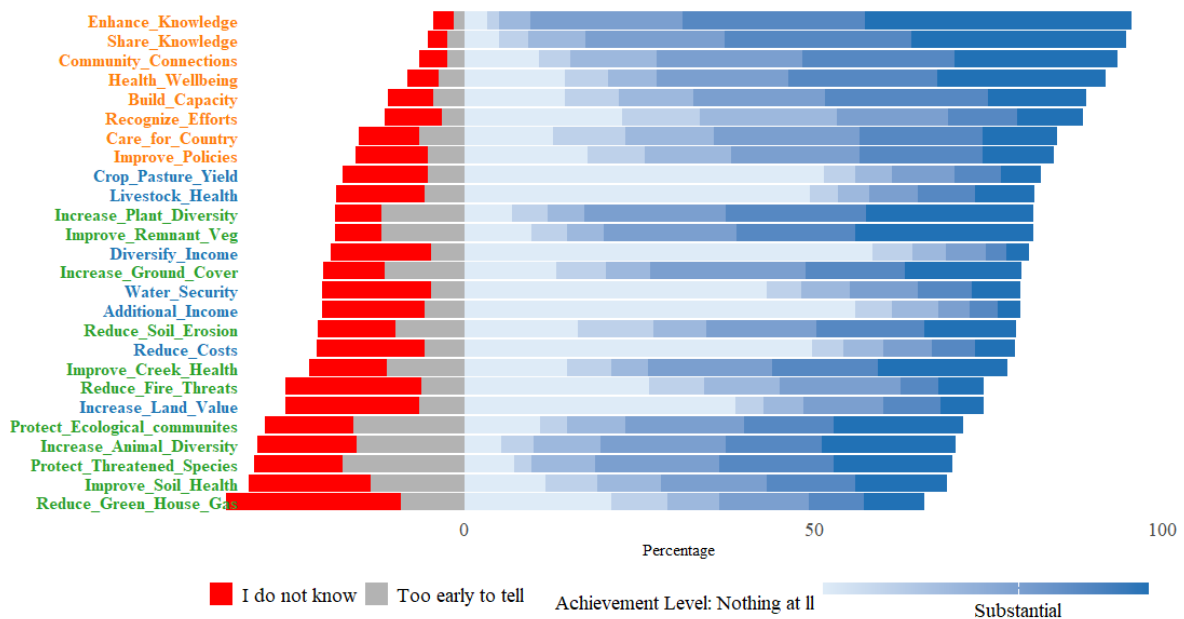


Figure adapted from Limenih et al. (in review).

Figure 14: Respondent perceptions of the extent to which different ecological (green text), economic (blue text) and social (orange text) objectives were achieved.

Correlation analysis and Principal Component Analysis revealed consistently positive cross-domain relationships, with no evidence of trade-offs among ecological, social, and economic indicators. We note, however, that this result is for the selected self-reported indicators for our sample and do not establish that all trade-offs are absent in practice, or that social gains cause ecological gains since potential costs, unevenly distributed benefits and unsuccessful activities may not be captured fully in data.

Structural Equation Modelling showed that ecological and social dimensions were the strongest predictors of overall perceived success, while economic outcomes were indirectly influential through their positive associations with other domains (Figure 15). These findings demonstrate that for our sample and dataset social success is positively associated with ecological success. Further research could further test where else that does (or does not) hold true, flagging the critical need for more integrated social–ecological approaches in NRM design, evaluation and research.

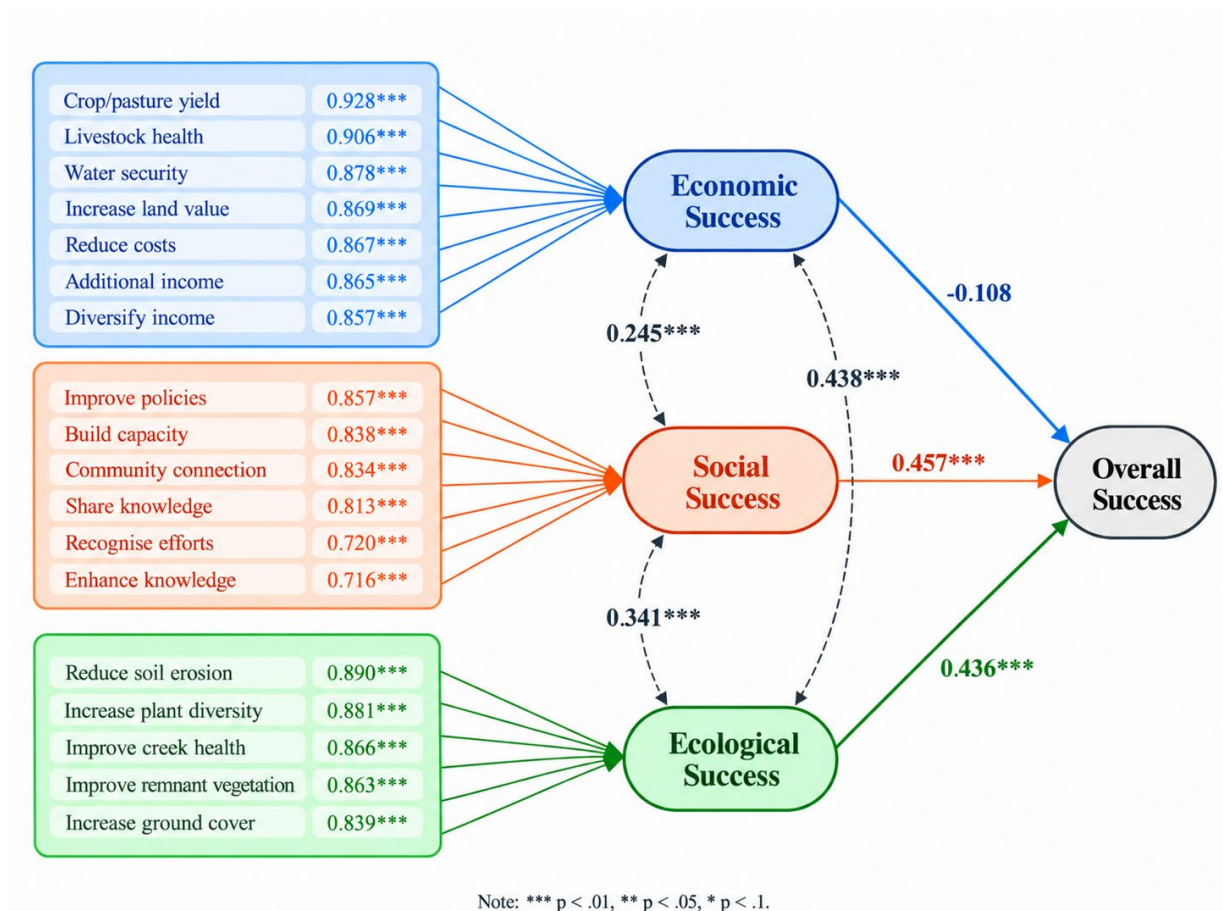


Figure adapted from Limenih et al. (in review).

Figure 15: Results from a structural equation model, showing relationships between different types of economic, social and ecological ‘success’ and their contribution to overall success.

Noting that almost 50% of the surveyed activities had commenced prior to 2016 (Figure 6), we find that ecological outcomes exhibited the greatest temporal lags, with respondents frequently reporting that it was “too early to tell” when asked about ecological outcomes; far fewer respondents told us that it was “too early to tell” when asked about social outcomes (Figure 16).

Both Figure 15 and Figure 16 are derived from data that describes respondents’ perceptions. As discussed in section 4.3, they are a very experienced group, so their perceptions are likely to reflect important realities. But without further research that helps check the correspondence between subjective and objective assessments, and which also helps to disentangle numerous other potentially confounding factors (e.g., activity age), we cannot claim that this ‘proves’ ecological outcomes take longer to emerge than social outcomes and that social outcomes lead to ecological. We do note, however, that these observations are consistent with findings in the broader literature about the length of time required to create and detect lasting ecological improvements. They are also consistent with much of the literature that considers development/aid programs (often grounded by the theory of change), which flags that one must first ensure the system can support and sustain activities, before expecting those activities to deliver targeted outcomes.

Our results thus suggest that it may be useful to consider developing and appropriately resourcing, at least a handful of prototype longer-term tiered monitoring frameworks (like those used for foreign aid), that use early-manifesting social indicators alongside longer-term ecological measures and that

are tested on several different NRM activities across several different contexts. Retaining data from these prototype tiered frameworks would subsequently provide analysts with information that is not currently available, with the potential for deeply insightful evaluations and learnings. This could make it possible to develop, test, and adaptively adjust long-term tiered monitoring frameworks that could be applied more broadly.



Figure adapted from Limenih et al. (in review).

Figure 16: Proportion of respondents who report felt it was 'too early to tell', or that the 'did not know' whether the NRM activity in which they had participated had generated a particular type of success.

7 Identifying factors that contribute to different types of success

This section of the report summarises and paraphrases sections of Limenih et al. (in prep).

Previous research clearly highlights that there are numerous confounding and interacting factors which, together, determine the ecological, social and/or economic outcomes (success) of NRM activities and projects. Evidence suggests that building and maintaining social capital is necessary but not sufficient for positive environmental change (Measham et al., 2011); among other things, the way in which scientific knowledge is used (Walsh et al., 2019), the alignment of preferences and values across stakeholder groups (Taylor et al., 2022), and policy/ program design (including governance) have critically important roles in determining final outcomes (Engert and Laurance, 2023, Black et al., 2011, Woinarski et al., 2017, Ansell et al., 2016). Moreover, we know that unanticipated environmental, social and economic events (e.g., extreme weather events, changes in government policy, changes in technology) can interrupt activities and affect outcomes (Limenih et al., 2026). But few studies have considered a broad range of factors, or a broad range of outcomes instead focusing on the role of just one or two (e.g., the impact of climate on ecological outcomes). This makes it difficult to get a ‘big picture overview’ of factors that contribute to multidimensional successes in complex, connected system.

We analysed the survey data to identify a broad range of different factors associated with different types of success.

We used two different statistical approaches to do this. First, we used a seemingly unrelated regression (SUR) model to identify factors that influence respondent perceptions of success across ecological, social and economic domains (see Figure 15, Section 6). The independent variables tested in these models, derive from our ‘whole of system’ conceptual model developed at the onset of the project (Figure 1) are listed in Table 4. We also used Multivariate Analysis of Variance (MANOVA) tests using Pillai’s Trace to determine whether those variables had a statistically significant joint association with the combined set of success outcomes. Figure 17 shows the standardised effect sizes of significant variables; Table 4 synthesises information across models showing variables that had a significant and positive (blue shading), a significant and negative (red shading) association in the SUR model, or a statistically significant joint association in the Manova.

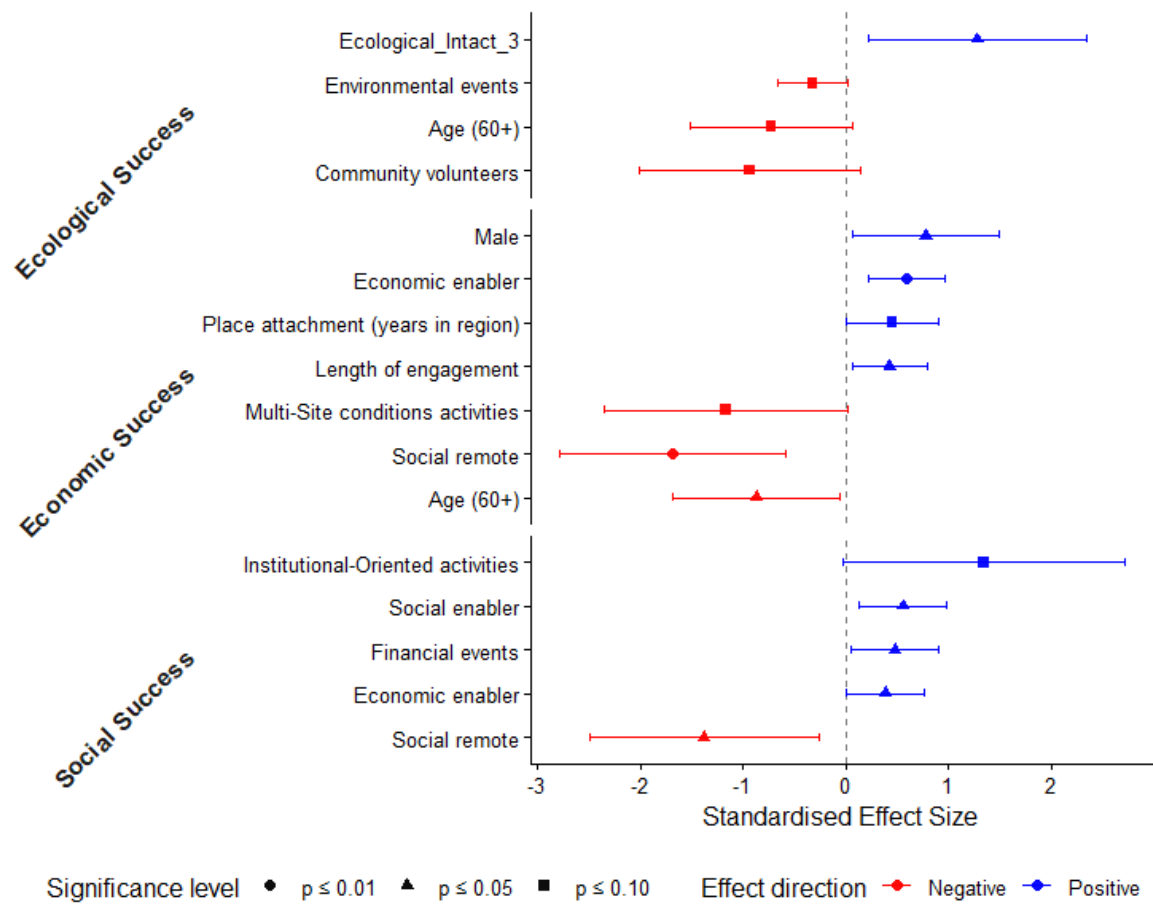


Figure adapted from {Limenh, in prep #40}.

Figure 17: Standardised coefficients from the seemingly unrelated regression (SUR) for the three success outcomes: ecological success, economic success, and social success.

Table 4: Variables used in the models that sought to identify factors associated with ‘success’ and their statistical significance

Blue (red) shading indicates that a variable is positively (negatively) associated with the type of success flagged in the column header and that the associations is statistically significant. Number of stars indicates level of statistical significance of variables when testing for significance of joint association across the combined set of outcomes (***) <0.001; ** <0.05; * < 0.1); all models used the same subset of respondents (N=154) for which we had a complete set of data (without missing observations).

Variable type and link	Variable	Ecological success (1)	Economic success (2)	Social success (3)	Joint success (1, 2 & 3) <i>Manova (Pillai's trace)</i>
Broad type of actor – see Figure 11, section 5	Independent landholders – compared to Institutional professionals				*
	Community volunteers – compared to Institutional professionals				***
	Volunteer coordinators – compared to Institutional professionals				**
Broad type of activity – see Figure 12, section 5	Multisite activities – compared to independent private land activities				*
	Institutional oriented activities – compared to independent private land activities				*
	Regional stewardship activities – compared to independent private land activities				*
Enablers – see Figure 8	Economic enablers				***
	Social enablers				**
Unexpected events – see Figure 9	Environmental events (mean -0.71)				
	Social events (mean -0.67)				
	Economic/Financial (mean 0.02)				
Activity	Years since activity first started				**
Socio-demographic characteristics of respondent – see Section 4.3.2	Years respondent has lived in the area				*
	Male (dummy variable)				
	Age_over_60 years (dummy variable)				
	Income_above_130k (dummy variable)				
	Number of adults in the household				
	Children in the household (dummy variable)				
Social-Ecological Context in which the activity takes place – see Table 3	Degree_or_Higher education (dummy variable)				***
	Ecological context				
	- the second least intact; compared to the least intact				
	Social context				
	- the most rural/remote compared to the most urban				
	- regional compared to the most urban)				**
	Interactive / land use				

The results allow for several broad generalisations.

- 1) All parts of our overarching conceptual model (Figure 1) are relevant, in that we found statistically significant associations between (perceptions of) success and actor type, activity type, enablers, unexpected events, the socio-demographic characteristics of respondents and the social-ecological context in which activities take place.
- 2) Community volunteers scored ecological successes lower than institutional professionals – perhaps because they felt they were not in as good a position to observe on-ground ecological improvements.
- 3) Multi-site activities were generally considered to generate fewer economic successes (e.g., improvements in livestock health) than other activities – perhaps because these activities are not focused on property/farm type outcomes, but instead on affecting broader ecological or social change in multiple locations typically not associated with agricultural production. In addition, activities distributed across multiple sites may involve greater coordination, monitoring, administrative, and implementation requirements; so must, by design, prioritise the generation of socio-institutional outcomes over economic outcomes.
- 4) Activities that were institutionally oriented were considered to generate greater social successes than independent private land activities – likely because that is the focus (primary objective) of many of these types of activities.
- 5) Our sample size was not large enough to consider the individual importance of each of the enablers listed in Figure 8, so we calculated an average score for each of two groups ('economic' and 'social'). We find that economic enablers were positively associated with perceptions of both economic and social success; social enablers were positively associated with perceptions of social success.
- 6) Similarly, our sample size was not large enough to consider the individual importance of each of the events listed in Figure 9, so we calculated an average score for each of three groups ('environmental', 'economic' and 'social'). We find that unexpected environmental events (the mean of which was negative) reduce perceptions of ecological successes; whilst unexpected economic/financial events (the mean of which was positive) are positively associated with (perceptions of) social success.
- 7) Relatively few of the tested socio-demographic variables were found to have a statistically significant impact, although both males and those who had lived in the region for many years were more apt to report higher perceptions of economic success than other respondents; those over 60 years of age were more likely to report low levels of both ecological and economic success than others.
- 8) Flagged in section 4.4, variables describing the characteristics of our regions are less well suited to the analysis of multi-site than single site activities, but even these imperfect measures are associated with perceptions of success. All else constant, our models suggest that activities that are undertaken in the most rural and socioeconomically disadvantaged regions are generally perceived as creating fewer social and economic successes than those undertaken in more urban areas. Similarly, it seems that activities undertaken in relatively degraded environments are seen to generate greater environmental improvements than those undertaken in the most degraded areas.

Future research, that helps improve our understanding of which specific enablers, unexpected events and social-ecological conditions affect outcomes most, in which contexts, is needed. However, our

findings highlight the importance of gathering information about, and of considering/analysing a wide range of factors when interpreting outcomes and when designing either portfolios of activities/programs or individual activities. The broader literature highlights that NRM activities occur in a complex interactive system and our models are consistent with that insight.

Focusing first upon enablers, one clearly needs to consider whether specific activities are appropriately supported for the context in which they are operating. In some areas, community volunteers may be essential contributors for action; flagging a consequent need to ensure that enablers set those volunteers up for success. But volunteer availability and capacity varies across localities: in some regions, activities will rely on paid coordination, delivery support and locally appropriate partnerships; in other contexts it may be important to ensure that social and economic enablers appeal to diverse land holders. Those charged with managing portfolios of activities across larger regions/landscapes are thus likely to need to engage with a broad range of actors, undertaking diverse activities, highlighting that no single type of enabler is 'best' across all contexts.

Focusing second, on unexpected events, our results suggest it is likely desirable to build flexibility into programs and activities, so that those charged with implementing them are able to respond to a wide range of unexpected events and changing conditions. One could, for example, allow agreed changes to timing, activities and milestones following drought, fire, flood, cost increases or policy changes, while retaining a record of the reasons and learnings – those records, ideally, being retained and integrated into longer term monitoring datasets, providing analysts with the information they need to generate more nuanced insights for policy and action.

Focusing, finally, on context – our results help to highlight an intuitively obvious point, namely of the importance of tailoring activities to suit both the ecological and the social conditions.

8 Identifying factors that predict sustained engagement

This section of the report summarises and paraphrases sections of Larson et al. (in review).

Understanding what motivates people to become engaged but also to sustain, in the long-term, their commitments to natural resources management (NRM) activities, is essential for the long-term sustainability of NRM programs (Measham and Barnett, 2008, Pages et al., 2018). Consequently, investigations that seek to learn more about factors associated with long-term engagement of diverse actors (shown in Figure 13) can be considered to be investigations into one type of ‘success’ – albeit a social success. A substantial body of research has examined initial motivations, often from a functionalist perspective that focuses on individual goals such as environmental concern, learning, or social connection (Clary et al., 1998, Gooch, 2003, Pages et al., 2018, Ryan et al., 2001, Sextus et al., 2024). But despite the fact that there is evidence to suggest that motivations change over time (Pages et al., 2018, Penner, 2002), far less is known about the factors that drive continued engagement over time, particularly among experienced participants. Moreover, studies often focus on single actor groups (e.g., volunteers, landholders, or institutional actors) or on specific dimensions of engagement, such as motivations or incentives, limiting comparability across contexts. For example, when studying volunteers, researchers tend to focus on their motivations (see, for example, (Haywood et al., 2024, Hossu et al., 2018, Prager, 2010). When studying institutional actors, researchers often seek to understand how participant roles and responsibilities align with policy and funding objectives (Hill et al., 2015, O'Bryan et al., 2023). And when studying landholders, researchers often seek to understand what makes them decide to dedicate parts of their land to conservation goals (Drescher and Warriner, 2022), or to explore the potential of monetary incentives (Greiner and Gregg, 2011, McDonald et al., 2018, Schaub et al., 2023). That different studies have focused on different groups or incentives has constrained understanding of how multiple drivers interact, and whether drivers are similar or different for different groups.

We combined our survey data with spatially explicit social–ecological indicators of the context in which activities take place, to holistically analyse factors associated with sustained engagement in NRM.

We gathered data about the activities respondents described (Figure 5) to populate each core part of our conceptual success model (Figure 1) – specifically setting out to include measures of:

- 9) **Context** - variables that describe participants themselves (including personal characteristics and socioeconomic condition - Table 1), and the broader environmental, social and economic conditions of the regions in which the NRM activities took place (Table 3)
- 10) **Experiences** - variables that describe participant interactions and experiences, including their roles/responsibilities when involved in the NRM activity, the supports and enablers

(or lack thereof) they had access to (Figure 8) and any external events that occurred during the activity which may have impacted progress (Figure 9) and

11) **Outcomes** - variables that describe the perceived outcomes of an activity (Figure 7).

We used random forest modelling to identify factors that most strongly predicted future intentions to engage in NRM activities. Our dependent variables (willingness to engage in the same activity again; and willingness to engage in a different activity) were both derived from responses to a question in the online survey, which used a Likert-style scale ranging from -5 (definitely not) to +5 (definitely yes), with 0 reserved for “not sure”. Most (73%) respondents selected “definitely yes” as their response to the question about whether they would engage in the same activity again (Panel A, Figure 18), and more than half (51%) selected “definitely yes” to a question about whether they would be willing to engage in a different activity in the future (Panel B, Figure 18). Our models thus used binary dependent variables (definitely yes or other) to characterise respondent willingness to engage in future NRM activities.

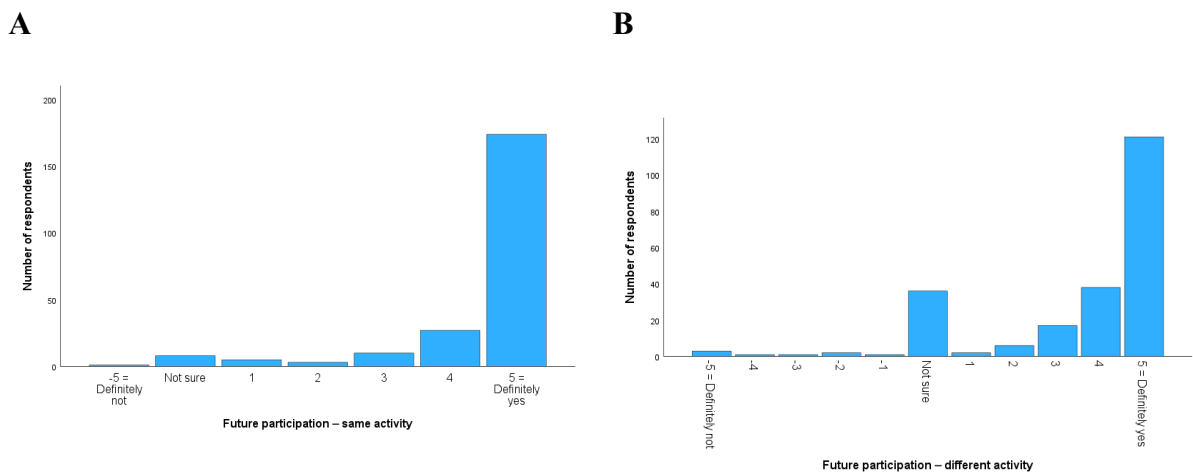


Figure 18: Respondent willingness to remain engaged in the same (panel A) or a different (Panel B) activity in the future.

Consistent with results from the statistical modelling approaches that were used to identify factors associated with different types of success (Section 7), these machine-learning models suggest that predictors of future willingness to engage in NRM activities also derive from all parts of a holistic ‘whole of system’ model (Figure 1).

Variables determining willingness to engage in a same activity in the future (Panel A, Figure 19) come from all three domains tested: context is important, with both the personal characteristics of participants and the characteristics of their regions helping to predict willingness to engage again – despite the fact that the variables describing the characteristics of our regions are less well suited to the analysis of multi-site than single site activities (see discussion in section 4.4). The role that individuals play is important, as well as the social enablers they are provided with and the external event they encounter along the way. And we find that outcomes matter: the higher the perceived success of previous activities, the higher the likelihood to be willing to engage again. Variables determining willingness to engage in a different activity in the future (Panel B, Figure 19) are however more highly skewed towards context: social enablers are still important, but the personal characteristics of participants, including roles, and the characteristics of their regions matter most;

neither the external events impacting (previous) activities nor the perceptions of success of those previous activities, appear to influence people's willingness to engage in something different in the future.

Two additional insights can be gleaned from this analysis. First, both models suggest that effects are non-linear: some predictors exhibit threshold effects, particularly social enablers, indicating that incremental improvements may have limited impact until sufficient levels are reached. Second, interactions among variables are important: the influence of individual variables depends on their interaction with others, highlighting the complexity of engagement dynamics in social–ecological systems.

We stress that neither our statistical nor our machine learning models 'prove' causation, but they identify several factors that could be further explored and/or capitalised on as methods of trying to further promote long-term engagement (with subsequent testing checking their efficacy). First, it seems that policies should recognise that the success of the entire NRM system requires contributions from diverse actors (Figure 13); the implication being that an indicator of system-wide 'success' is that diverse actors want to remain engaged. Our research shows that sustained engagement depends on interacting social, ecological, and experiential factors; engagement is unlikely to be superficially determined by any single driver. Second, the strong role of social enablers strongly supports findings from previous research and suggests that investment in capacity building, networks, leadership, and knowledge exchange helps build the long-term sustainability of the entire system (which requires diverse actors to contribute in complementary ways - Section 5). Third, the importance of context highlights the need to tailor interventions to local conditions, considering both socio-economic and ecological characteristics. Fourth, information about success should be widely shared, and the stewardship ethos of contributors embraced to bolster willingness to remain engaged. Finally, the influence of external events underscores the necessity of flexible, adaptive approaches that can respond to changing environmental, social and economic circumstances.

PANEL (A) Most willing to engage in same activity again



PANEL (B): Most willing to engage in a different activity in the future

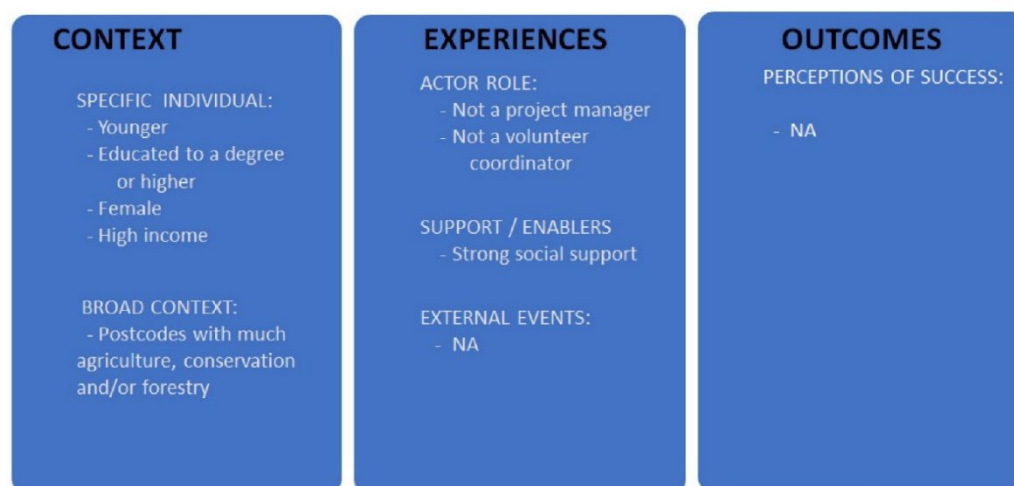


Figure adapted from Larson et al. (in review).

Figure 19: Factors predicting willingness to remain engaged in the same, or to start a new NRM activity in the future.

9 Policy synthesis

In this section we synthesise findings from across previous sections of the report, flagging how results can be used to help demonstrate and design for success. Before doing so, however, we reiterate points made earlier about the limitations of our data – our aim being to ensure that results are not incorrectly interpreted.

- Our findings are drawn from 244 voluntary survey responses concerning activities across 47 NRM regions. The survey data describes our respondents' experiences and their perceived outcomes; they should not be interpreted as representing the views of all people involved in Australian Landcare or NRM activities.
- Only 8 respondents identified as being of Aboriginal or Torres Strait Island descent. Our data cannot and should not be used to draw any conclusions about First Nations definitions of success or Caring for Country and the 48 activities that people describe as having some sort of link or association with Aboriginal or Torres Strait lander groups should be treated as providing First Nations evidence – research that seeks to identify 'success' in that context would need to be led by the relevant Traditional Owners and First Nations organisations.
- Our statistical analyses identify associations; they do not 'prove' causation.

Demonstrating success

Several of the analyses that are described in this report help identify variables that could be regularly measured and reported on to make visible the various successes of NRM activities including, but not limited to, those undertaken by or in association with the NLN, NRM Regions Australia, or DCCEE's Threatened Species Recovery Teams.

First, the analyses described within Section 6 (Limenih et al., in review), set out to determine (1) whether trade-offs or synergies exist among success indicators, (2) the relative contribution of different outcome domains to overall perceived success, (3) which outcomes are difficult for stakeholders to observe or self-assess, and (4) which require extended timeframes before meaningful evaluation is possible. It found no evidence of trade-offs, with evidence to suggest that social success is positively associated with ecological success; both of which contribute to overall success (Figure 15) – although we reiterate a point made earlier, namely that this result is for the selected self-reported indicators that our survey focused on, and which our sample reported on. So, these results do not establish that all trade-offs are absent in practice, or that social gains cause ecological gains since potential costs, unevenly distributed benefits and unsuccessful activities may not be captured fully in data. They do, however, strongly highlight the multidimensional nature of 'success'.

Success is multidimensional.

It is important to measure more than one type of success or outcome, rather than relying on a single measure, or just a small handful of metrics that focus on a single dimension (e.g., reporting on only ecological or only on social outcomes).

Second, the analysis highlighted that some outcomes are much more difficult to observe than others. Specific examples of ‘hard to observe’ outcomes are those in the top half of Figure 16 (for example, improvements in soil health or reductions in greenhouse gasses), the ‘easier to observe’ outcomes are in the bottom half (such as creating and sharing knowledge, or community connections); these are listed in Table 6, Appendix C. The analysis also suggests that different types of outcomes can, and perhaps even should, be monitored (or at least reported on) at different times, because of differences in the time that it takes different types of outcomes to emerge. Specific examples of outcomes that seem to emerge early, are those in the left side of Figure 16, those that take much longer to emerge are on the right side; with examples repeated in Table 7, Appendix C.

There is a need for long-term tiered and integrated monitoring frameworks that consider ecological, social and economic outcomes.

Where appropriate, these frameworks should use early-manifesting social indicators alongside longer-term ecological measures to avoid premature judgements of programme performance and leverage the expertise of on-ground practitioners to monitor and report on outcomes that are relatively easy to observe, with matching resources to support the keeping of those records.

Here too, we reiterate a point made earlier: without further research that helps check the correspondence between subjective and objective assessments, and which also helps to disentangle numerous other potentially confounding factors (e.g., activity age), we cannot claim that our analysis ‘proves’ that ecological outcomes take longer to emerge than social outcomes or that social outcomes lead to ecological outcomes. We do note, however, that our observations are consistent with findings in the broader literature about the length of time required to create and detect lasting ecological improvements. They are also consistent with much of the literature that considers development/aid programs (often grounded by the theory of change), which flags that one must first ensure the system can support and sustain activities, before expecting those activities to deliver targeted outcomes.

Third, the analyses described within Section 7 (Limenih et al., in prep), set out to identify factors associated with different types of success. It found that all parts of our overarching conceptual model (Figure 1) are relevant, in that the analysis identified statistically significant associations between (perceptions of success) and actor type, activity type, enablers, unexpected events and the socio-demographic characteristics of respondents (Table 4). Most relevant to the problem of ‘demonstrating’ success, is that unexpected ecological, social and economic ‘events’, all influence outcomes.

It is important to consider the wider context when interpreting outcomes ('success') to avoid incorrectly attributing changes that are due to exogenous ecological, social or economic events to a particular activity or program.

As such, monitoring programs may not only need to record and report on 'outcomes', but to also keep a record of exogenous events that may affect those outcomes, with matching resources to support the keeping of those records.

Tsai et al. (in prep) highlight that fully integrated, and strategically designed monitoring frameworks need to do more than just collect data that is meaningful, or considered important, to only a subset of those involved in the NRM system at a single point in time. They suggest that monitoring systems could – perhaps even should – be designed, and appropriately resourced, to record complex ecological and social outcomes, provide credible accountability, and inform management without overburdening contributors. Coupling those insights, with insights from the research presented in this report, we suggest that it may be useful to consider developing and appropriately resourcing, at least a handful of prototype longer-term tiered monitoring frameworks (like those used for foreign aid), that use early-manifesting social indicators alongside longer-term ecological measures, for testing across several different types of NRM activities implemented across several different contexts. Whilst recognising that specific data requirements are context/activity dependent, our research suggest that such a framework could usefully capture system-wide information (e.g., about Context, Experience and Outcomes) which could subsequently be used to demonstrate and assess outcomes. Measures would be collected at various points in time, starting with initial baseline data, ideally collected before an activity commences. Moreover – and in line with Tsai et al. (in prep) – we suggest that these systems could seek to combine formal measures with situated observations that are collected and managed by diverse actors so that no single group is expected to carry the entire monitoring burden. We note the related need to consider governance issues around that data – determining who holds it, who can access it, what contributors have agreed can be shared, and how sensitive locations and cultural knowledge are protected, recognising that in some cases, it may not be possible to assume that all data can be published.

We stress that simply collecting information will not, by itself help improve the design of future endeavours: there must also be a step that effectively 'closes the loop' – ensuring that monitoring data, is effectively collated, integrated across scales, and made readily accessible for analysis (Tsai et al., in prep). Having access to more, and more 'harmonised' data relevant to diverse activities across multiple locations would also substantially redress the data-problem identified in Section 4 enabling future analysts to more comprehensively evaluate activities, thus learning more about the diverse factors associated with success, whilst controlling for potentially confounding factors. This would help to avoid erroneously attributing changes to specific activities that might, instead, be attributable to other (otherwise unobserved) factors.

Our research clearly shows that it is not only important to look at multiple different actors, but it is also important to look beyond single metrics or 'domains'. More specifically, our work highlights the need to consider ecological, social and economic factors that describe context, experiences and

outcomes (almost a 3 x 3 matrix). Table 8 (Appendix D) provides examples of the types of variables, categorised into groups that align with our initiating framework (Figure 1). The variables used in that table are a subset of those which our analyses identified as being associated with different types of success that could be used to help guide conversations about more holistic monitoring and evaluation systems. We stress that these are illustrative examples only, rather than definitive suggestions. More generally, our work allows us to flag some broader categories of variables that are important to consider:

- The ecological, socioeconomic context in which a region takes place. This does not necessarily mean that every NRM activity needs to collect this data since much is publicly available and, as demonstrated in this report, can be linked to survey data, providing additional insights that would be otherwise unavailable (e.g., about both ecological and socioeconomic context).
- Ecological, social and economic ‘events’ that may have impacted an activity. Our work clearly suggests that it is not only things like drought, fire, and floods which matter: socioeconomic changes (including things like COVID, changes to government policy, changes in technology) can also influence outcomes. Here again, this should not be taken to suggest that every activity needs to collect its own ‘event’ data. It may be desirable to collect some site, or activity-specific data (e.g. asking participants to record ‘significant events’ – and not restricting that to environmental phenomena). But much other contextual data may be recorded publicly (e.g., dates of COVID lock-down; dates when government policies changed, interest rates and inflation).
- A diverse array of enablers appropriate for particular activities and contexts.
- A diverse array of ecological, social and economic outcomes.

Designing for success

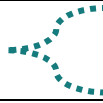
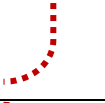
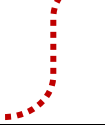
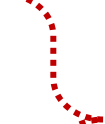
Until such a time as we have a comprehensive database such as that, many of the results reported on in the preceding sections of this report provide useful (interim) insights for those who plan to design either individual NRM activities or entire NRM programs with the best chance of success. First, amongst other things, the analysis reported on in Section 5 looked for evidence of trade-offs and synergies between objectives, by first asking respondents to tell us about the importance of 26 different ecological, social and economic objectives when deciding to engage in NRM activities and then using principal components analysis to identify shared objectives. It found 5 statistically distinguishable groups, shown in Figure 10. In addition, the analysis reported on in Section 6, looked for evidence of trade-offs between the different ecological, social and economic outcomes considered in our on-line survey; finding none.

Table 5 combines insights from both analyses, highlighting the specific objective / outcomes that we found to be most synergistic, for the set of outcomes we considered and for those who responded to our survey (noting also, that we found no evidence of trade-offs). We emphasise that the short-form descriptions of what can be quite complex outcomes, mask much underlying detail that needs to be better unpacked, explored and understood. This is particularly true for the objective “To look after Country in a culturally appropriate way’ – a phrase used within the on-line survey as a well-intentioned albeit inadequate place-holder for what is critically important to First Nations people and for Country. We stress that First Nations people and organisations need to guide how cultural authority, relationships with Country, cultural continuity and self-determined outcomes are

represented and note that measures, interpretation and permissions for sharing cultural knowledge should be agreed with the relevant knowledge holders.

Table 5: Synergistic objectives and perceived outcomes.

Brackets show items that most strongly grouped together.

Most strongly synergistic objectives (at the start of project)	Objective / Outcome	Most strongly synergistic outcomes (perceived achievement)
	To reduce greenhouse gas emissions	
	To reduce soil erosion	
	To improve soil health/soil biodiversity	
	To improve the health of creeks, swamps, or wetlands	
	To increase native perennial ground cover	
	To improve the health of remnant vegetation	
	To increase the diversity and abundance of native plant species	
	To increase the diversity and abundance of native animals	
	To protect endangered or threatened ecological communities	
	To protect endangered or threatened species	
	To increase my connections with the community	
	To increase the capacity of the community or local institutions to manage natural resources	
	To improve local natural resource management plans and policies	
	To create opportunities for sharing knowledge and experience	
	To enhance my knowledge and experience	
	To maintain or enhance my health and wellbeing	
	To 'look after Country' in a culturally appropriate way	
	To have my conservation efforts recognised	
	To enhance my knowledge and experience	
	To diversify sources of property income	
	To generate additional property income	
	To reduce costs	
	To increase the value of the land or property	
	To improve livestock health or productivity	
	To improve pasture or crop yield	
	To improve water storage/security	

Second, additional analysis reported on in Section 5 (Tsai et al., in review), shows that NRM initiatives rely on a variety of different 'actors' which can be categorised into four broad groups: institutional professionals, volunteer coordinators, community volunteers, and private land holders. These 'actors' make different, complementary, types of contributions to NRM activities at property, community, regional and institutional levels, each primarily motivated by environmental objectives (e.g., improving the ecological condition of land, or species protection and recovery); other social and economic motivators/objectives existed, but there were somewhat divergent views about their importance across actor groups (Figure 11).

Success may depend less on simply maximising the participation of individuals or maximising the number of activities that pursue a single objective, but rather on supporting different people and organisations to undertake different activities.

It may, therefore, be both possible and desirable to
(a) design suites of activities that capitalise on synergistic relationships between different activity outcomes; and
(b) construct more nuanced visions to engage with different groups – e.g., using environmental objectives as an access point, but also highlighting social objectives when reaching out to volunteer coordinators and institutional professionals

Third, in addition to the indicators that are listed in Appendix C which could be used to monitor and report on ‘success’, the analyses that are described in sections 7 (Limenih et al., in prep) and 8 (Larson et al., in review) identified numerous factors that are associated with or may help predict success, including factors predicting participant willingness to remain engaged with NRM activities into the future. These factors, summarised in Table 9, Appendix E, can be specifically linked to individual variables that could potentially be used for monitoring – perhaps even used to inform future discussions and research about whole of system monitoring and evaluation frameworks. Importantly, they can also be used to inform the design of specific activities – e.g., aiming to ensure that a variety of different actors are included in a comprehensive program of linked activities, perhaps with individual groups of actors encouraged to participate in a diverse range of complementary activities (e.g., on-ground activities, coordination / management /administration, monitoring and reporting) by focusing on the types of objectives most important to each.

Resources, experiences, place and unexpected ecological, social or economic events can all influence outcomes; they may also affect whether people want to stay involved or participate in similar activities again.

These factors can be

- (a) usefully monitored, noting that marked changes in some of these variables may provide an 'early' signal or indicator of potential long-term (environmental) outcomes (e.g., a failure to attract or retain key actors could signal upcoming problems maintaining an effective NRM System as a whole); and/or*
- (b) usefully considered when designing individual activities or programs of activities (e.g. aiming to maximise the engagement of diverse participants, tailoring social and economic 'enablers' to suit particular contexts, or adapting activities and programs in response to following 'unexpected' environmental, social or economic change)*

Concluding comments

The success of Australia's NRM system, and the multitude of programs and activities contained within, is inherently multidimensional in that positive environmental change requires both social and ecological successes, made possible when a wide range of 'actors' undertake complementary activities. Documenting, and designing for, success thus requires that one takes both:

- a) A targeted view, to plan for, report on, and support the diverse activities undertaken by individual actors, considering both the ecological and socioeconomic context in which activities take place, monitoring and reporting on multidimensional successes – using a tiered (time appropriate) system – whilst also recording 'unexpected' ecological, social and economic events to avoid subsequent evaluations erroneously attributing changes that occur from exogenous events to a specific activity or program; and
- b) A whole of system view to plan for and develop a suite of complementary physical, social/institutional activities (Figure 13) and monitoring/reporting strategies – including the governance, coordination, administration and other arrangements required to support, enable and sustain diverse on-ground activities at multiple scales, for lasting success.

While this study provides important insights into perceived NRM success, its limitations highlight several priorities for future research. First, much of the data used in our analyses described peoples' perceptions of success. Perceptions are substantively important because they affect legitimacy, participation, and continued engagement, but they do not necessarily correspond perfectly with 'objective' metrics (e.g., an x% increase in the population of a particular species). Future research could usefully seek to determine when and where perceptions align best with objective metrics, potentially using insights to help prioritise monitoring activities (by, for example, using perceptions

where alignment is likely; and using scarce resources to collect other ‘objective’ metrics where perceptions are potentially misleading)

Second, consistent with the wider NRM literature, our results reinforce that NRM activities operate within complex and interconnected social-ecological systems, and outcomes should be analysed with that in mind. That said, our relatively small dataset prevented us from being able to explore and disentangle important details. Future research is needed to improve understandings of which specific enablers, unexpected events, and social-ecological conditions most strongly influence NRM outcomes, and how these effects vary across contexts. This includes, but is not limited to, research that compares initiatives that have access to different levels of support for coordination to examine whether stronger connections improve continuity and ecological outcomes.

Third, our results underscore the importance of taking a ‘whole of system’ view – designing, both individual activities and entire portfolios of NRM activities/programs as each contributing to the system in different ways, with consideration (and resourcing) to provide long-term support for diverse actors to undertake that work – including resources for coordination, maintenance, and monitoring. Future research could usefully seek to assess the extent to which holistic approaches like those influence final, ‘whole of system’ outcomes, perhaps comparing them with piecemeal approaches for additional policy insights.

Finally, we note that those who might wish to undertake research to learn more about the influence of diverse variables on NRM successes in complex connected systems (be it enablers, institutional designs or other), require access to good-quality data, information, long-term residents and experienced practitioners, that can lend insights about a broad range of factors, and the way they have varied over time and across space. This underscores the importance of further developing and testing prototype systems for recording meaningful information, reviewing and refining those systems, making that data publicly available whenever appropriate, and promoting its use for more comprehensive evaluations to support future learnings. We invite researchers, partners and willing groups to test some of our ideas, perhaps starting by first reporting on ecological, social and economic aspects of context, activities and outcomes, in a few pilot test-cases across different contexts, reviewing the burden, usefulness and evidence quality, and then adaptively adjusting the system in response to that review before adopting more widely.

Appendix A: Online survey



The research is being conducted by researchers at the University of Tasmania, the National Landcare Network, the NSW Department of Climate Change, Energy, the Environment and Water, and Western Sydney University. The project is, funded by the National Environmental Science Program, and has been approved by the University of Tasmania's Human Research Ethics Committee (approval #30924).

If you have any queries, concerns or issues with this study, please contact the research team at: successlandscapes@utas.edu.au or call 03 6324 9111.

Success Factors for Resilient Landscapes Survey

Thank you for your interest in this study, which seeks to understand the success factors behind natural resource management activities by learning from those directly involved. These activities encompass a wide range of actions, such as

- planting trees to restore landscapes,
- protecting endangered species,
- adopting sustainable farming practices, and
- improving the natural environment.

Your responses will help government and non-government organisations develop strategies that better support landowners, and communities in achieving more sustainable and resilient landscapes across Australia.

The survey explores three main themes: (a) your involvement in the activity, (b) your motivations and objectives, and (c) factors that help or hinder your efforts. It will take approximately 25–30 minutes to complete.

To encourage participation, we are offering incentives for those who complete the survey. At the end of the survey, you will be asked if you would like to go in a draw to win a prize. There will be a total of seven prizes, and all winners (drawn randomly) will be provided with free conference registration and \$1,000 to support travel and accommodation. You will be given the opportunity to tell us which conference you would like to go in the draw for - there are two tickets available for both the National Landcare Conference and the Australian Citizen Science Association conference, there is one ticket available for each of the others:

- **NRM Knowledge Conference** – Cairns, 8th–12th September
- **The National Landcare Conference** – Gold Coast, 21st–24th September
- The National Farmers Federation Conference - AgXchange – Gold Coast, 23rd–25th September
- The Australian Citizen Science Association Conference – Melbourne, 13th–15th October
- The Ecological Society of Australia Conference – (*Awaiting details of date and location*)

Before starting this survey, please confirm that you have read the Participant Information Sheet ([access HERE](#)) and in particular that you understand the following:

- Your participation is entirely voluntary. If you start and decide to stop at any point, you are free to do so.

- Your survey responses will only be accessible by the research team.
 - All data from this survey will be de-identified and treated with the utmost confidentiality.
- ☐ I have read the information sheet and consent to participate in this study

☐ I do not agree to participate in this study <Exit survey>

Preliminary Questions [Participant Identification and Eligibility]

Which of the following best describes you? (Select all that apply)

- A. ☐ I own land or manage land for someone else (excluding managers of parks/reserves). [\[direct to S1.1\]](#)
- B. ☐ I am the manager of a local, state or federal park/reserve. [\[direct to S1.1\]](#)
- C. ☐ I engage in natural resource management activities on land which I do not manage. [\[direct to S1.1\]](#)
- D. ☐ I am a coordinator, manager or expert advisor for natural resource management activities. [\[direct to S1.1\]](#)
- E. ☐ None of the above. [\[direct to P.1\]](#)

For those selecting "None of the above" in question P.1, present P.2 to P.7.

P.1. Did any of the following make it difficult for you to participate in natural resource management activities during the last 5 to 10 years?

0 = Not a problem at all; 5 = Completely prevented me from participating

1. COVID-19
2. Wildfire(s)
3. Flood(s)
4. Drought(s)
5. Storm(s) / Cyclone(s)
6. Landslide(s)
7. Existing problems with invasive weeds
8. Existing problems with pest animals (e.g. rabbits)
9. Extreme temperatures (e.g. heat waves or cold snaps/frost)
10. Government policies or processes relating to natural resource management
11. Life events (e.g. ill health, heavy workload, complicated family life)
12. High operating costs (on farm or elsewhere)
13. Low income (on farm or otherwise)
14. Lacking the right machinery and equipment
15. Difficulty with communications and information technology
16. Other (please specify)

P.2. Do any of these additional issues discourage you from participating in natural resource management activities?

0=Not discouraging at all; 5 = Completely prevents me from participating

1. Family and friends do not have a supportive attitude towards natural resource management activities.
2. Community does not have a supportive attitude towards natural resource management activities.
3. There is a lack of evidence that the actions work.
4. Lack of knowledge/advice from Aboriginal and Torres Strait Islander people or organisations.
5. Lack of previous personal experience with natural resource management activities.
6. Lack of local knowledge, experience, or advice about how to undertake natural resource management activities (e.g. from friends, family, neighbours, and nearby landowners).
7. Lack of advice/information from people outside the local community (e.g. agronomists, agricultural extension officers, researchers, and other scientists).
8. Lack of information from threatened species plans, regional natural resource management plans, or other relevant plans/documents.
9. There is a lack of financial incentives linked to outputs/outcomes (e.g. payments for carbon, ecosystem services).
10. There is no ongoing security of funds for undertaking the activity (i.e. rather than short-term funding).
11. There are no compensation payments (e.g. for lost potential income, opportunity costs).
12. There are no funds to help with the cost of materials/equipment to undertake the activity.
13. Lack of assistance with the paperwork required to apply for funding.
14. Lack of assistance with other administrative work required to participate in the activity.
15. Lack of supportive and effective leadership/management of the activity.
16. Lack of additional labour to undertake the activity.
17. Lack of other resources to undertake the activity (e.g. plants, fencing).
18. Lack of time to plan for and prepare before undertaking an activity.
19. Other (please specify).

P.3. What is your age?

In years _____

P.4. What is your gender?

- a. ☐ Female
- b. ☐ Male
- c. ☐ Non-binary
- d. ☐ Prefer not to say
- e. ☐ Prefer to self-describe _____

P.5. In which postcode do you live?

Postcode: _____

P.6. Would you be interested in participating in an interview to understand the support needed for people to participate in natural resource management activities?

☐ Yes [direct to IRQ.2]

☐ No

P.7. Is there anything further you would like to say about the property or natural resource management practices, or anything you think it would be useful for us to know?

.....

[end survey for people who have not participated in NRM activities]

Section 1A

S1.1. Which of the following broadly describe the activities you are currently involved in or have previously been involved in?

Please select all that apply.

1. Planting native trees, shrubs, and/or ground-layer species
2. Working to improve community attitudes towards conservation
3. Coordinating or otherwise supporting people who are undertaking on-ground activities
4. Setting aside land for conservation
5. Introducing logs or woody debris
6. Monitoring for invasive pests and weeds
7. Monitoring for native plant or animal populations
8. Undertaking groundworks for erosion control
9. Planting non-native trees
10. Controlling feral animals
11. Practicing ecological fire management
12. Practicing cultural fire management
13. Fencing riparian zones or wetlands/swamps
14. Fencing existing remnant native vegetation (excluding riparian or wetlands/swamps)
15. Using herbicides to control non-native invasive weeds
16. Manually removing non-native invasive weeds
17. Using herbicides to control invasive native weeds/scrub
18. Manually removing invasive native weeds/scrub
19. Constructing wetlands, designing, or enhancing on-farm water storages/dams
20. Translocating or reintroducing threatened animals/plants
21. Building nesting boxes or artificial hollows
22. Practicing no-till or no-kill cropping of native pastures
23. Establishing off-stream watering points
24. Establishing native forage shrubs
25. Sowing/establishing perennial pasture
26. Closing water points
27. Undertaking planned, rotational, or holistic grazing management of native pastures and native vegetation
28. Managing total grazing pressure
29. Rotating crops, reducing tillage, stubble retention
30. Using cover crops
31. Improving water use efficiency
32. Reducing the use of inorganic fertiliser
33. Other (please specify) _____
34. Nothing at all [\[direct to P.1\]](#)

Section 1B

S1.2. In your opinion, which of the activities you selected were 'successful'? Please select all that apply.

☐ Appear each activity that has been selected 'currently' and 'previously' [from S1.1.](#)

Section 1C

We genuinely value your time and understand that you may not provide details on every activity you've been involved in. Therefore, we will ask questions about one activity, with the option to answer the same set of questions for another activity before completing the survey, if you previously selected more than one.

S1.5. Please select one of the following activities (which you've previously selected) that you would like to answer the survey questions about.

Appear each activity that has been selected 'currently' and 'previously' [from S1.1.](#)

S1.6. What was the primary objective of [Selected activity]? (e.g. saving a particular species, reducing agricultural run-off, strengthening social connections)

.....

S1.7. Was that objective achieved?

“Definitely not”, “Absolutely yes” and “☐ Too early to tell”, “☐ Not relevant”.

S1.8. In which year did you first start [Selected activity]?

_____. (if you are unsure, please provide the closest estimate)

S1.9. In which year did you finish [Selected activity]?

☐ Finished in ____

☐ Ongoing

S1.10. When [Selected activity], did you engage with, or form partnerships with, any of the following groups / programs? (Please select all that apply)

- Please select all that apply to view a more specific list of groups/programs in the next question.
- If you are not sure about how to respond, you can select the broad group/program and can then see more details before deciding.
- ☐ An Aboriginal and/or Torres Strait Islander led program or activity [\[Show S1.12a\]](#)
- ☐ A national program or group --- Please indicate which program or groups [\[Show S1.12b\]](#)
- ☐ A regional, state, or local program or group --- Please indicate which groups [\[Show S1.12c\]](#)
- ☐ This activity was undertaken independently (i.e. there was no association with any formal natural resource management group or program) [\[direct to S1.13\]](#)

S1.12a. Please indicate which of the following more specific 'Aboriginal and/or Torres Strait Islander led groups or programs' you were involved with when [Selected activity]. Select all that apply.

- ☐ An Indigenous Protected Area
- ☐ An Indigenous Ranger Program ☐ Other (please specify)

S1.12b. Please indicate which of the following more specific 'national groups or programs' you were involved with when [Selected activity]. Select all that apply.

- ☐ Landcare program or group
- ☐ The Environmental Stewardship Program,
- ☐ The Pest and Disease Preparedness and Response Program
- ☐ The Saving Native Species Program

- ☐ The National Soil Conservation Program
- ☐ The Natural Heritage Trust
- ☐ The National Action Plan for Salinity and Water quality initiative/project
- ☐ Caring-for Country
- ☐ Australian Citizen Science Association
- ☐ Other national program (please specify) _____

S1.12c Please indicate which of the following more specific 'regional, state, or local groups or programs' you were involved with when [Selected activity]. Select all that apply.

- ☐ One of Australia's 56 Natural Resource Management organisations, or their associated boards
- ☐ A State/Territory landcare group
- ☐ A State/Territory threatened species recovery team
- ☐ A local landcare group
- ☐ A local bushcare group
- ☐ A local coastcare group
- ☐ A local catchment care group
- ☐ A local dunecare group
- ☐ Waterwatch
- ☐ Other (please specify) _____

S1.11. In what capacity did you engage with the chosen groups/programs when undertaking [Selected activity]? Select all that apply.

- ☐ Community volunteer
- ☐ Coordinator or facilitator (volunteer)
- ☐ Coordinator or facilitator (paid)
- ☐ Expert advisor
- ☐ Project/department manager
- ☐ Fund manager
- ☐ Other (please specify) _____

S1.12. Approximately, on average, how much time have you spent on [Selected activity]? Please provide your answer in one of the following formats:

___ days per week

___ days per month

___ days per year

S1. 15a. Were other people involved in, or did they help you when [Selected activity]?

☐ Yes

☐ No [skip to S1.16]

S1.13. Please describe the type of assistance, how frequently it occurred, and any other relevant details.

S1.14. Were the activities occurring on a property that you own, manage or otherwise make decisions for ?

☐ Yes – in a local, state or federal park/reserve [show s.17 to s.19 - skip S1.20 to S1.22]

☐ Yes [show S.16-S.20, skip S1.21 and S1.22]

☐ No [skip to S1.21]

S1.15. What is your role on that property?

If more than one property, please tell us the location of the property where most of the work was undertaken.

☐ Owner

☐ Manager

☐ Resident

☐ Other (please specify) _____

S1.16. Where is the property located?

Town (or nearest Town): _____ Postcode: _____

S1.17. What is the total size of the property?

Hectares (approximately): _____

S1.18. When [Selected activity], approximately how much of the land on that property was involved?

Hectares (approximately): _____

S1.19. Which of the following activities/businesses are undertaken on that property? Select all that apply.

☐ Dairy farming

- ☐ Livestock grazing of native pastures/vegetation, excluding dairy (e.g., cattle, sheep)
- ☐ Livestock grazing of modified or irrigated pastures, excluding dairy (e.g., cattle, sheep)
- ☐ Intensive livestock grazing (e.g., horse studs, piggeries, poultry farms)
- ☐ Cropping – dryland
- ☐ Cropping - irrigated
- ☐ Horticulture - Perennial (e.g., fruit trees, flowers, berries, vegetables from plants that live for more than 2 years)
- ☐ Horticulture - Seasonal (e.g., melons, flowers, herbs from plants that live for less than 2 years)
- ☐ Plantation forestry
- ☐ Carbon farming as a business enterprise
- ☐ Nature repair or biodiversity conservation as a business enterprise
- ☐ Tourism
- ☐ Other (please specify) _____

S1.20. When [Selected activity], was it in one area/region or in multiple locations?

- ☐ Mostly in one area/region. ☐ Multiple locations.

S122b1 If mostly in one area/region, please tell us the location. Please tell us where:

Town (or nearest Town): _____

Postcode: _____

S122b2 If multiple locations, which states or territories? Select all that apply, and specify the nearest town or region/area in the text box.

☐ ACT _____ ☐ NSW _____ ☐ NT _____ ☐ SA _____

☐ QLD _____ ☐ VIC _____ ☐ WA _____ ☐ TAS _____

Section 2

S2.1 How important were each of the following objectives when you first chose to participate in “Selected Activity” And how much has been achieved?

For each of the items, participants answer sub questions A and B.

- A. How important was this objective? 0 = Not an objective; 5 = Critically important
B. How much was achieved (even if not an original objective)? 0 = Nothing at all; 5 = Substantial achievement; Too early to tell; I do not know

2.1.1 Environmental or Ecological

1. To reduce greenhouse gas emissions.
2. To reduce soil erosion.
3. To improve soil health/soil biodiversity.
4. To improve the health of creeks, swamps, or wetlands.
5. To increase native perennial ground cover.
6. To improve the health of remnant vegetation.
7. To increase the diversity and abundance of native plant species.
8. To increase the diversity and abundance of native animals.
9. To protect endangered or threatened ecological communities.
10. To protect endangered or threatened species.

Please feel free to share any information or data that demonstrates how you feel you have achieved 'environmental or ecological objectives'.
(Optional)

2.1.2 Farm, Business or Property

1. To enhance my knowledge and experience
2. To diversify sources of property income.
3. To generate additional property income.
4. To reduce costs.
5. To increase the value of the land or property.
6. To improve livestock health or productivity.
7. To improve pasture or crop yield.
8. To improve water storage/security.

Please feel free to share any information or data that shows how you feel you have achieved 'farm, business or property objectives'. (Optional)

2.1.3 Personal, Social, Institutional or Cultural

1. To enhance my knowledge and experience.
2. To maintain or enhance my health and wellbeing.
3. To have my conservation efforts recognised.
4. To increase my connections with the community.
5. To increase the capacity of the community or local institutions to manage natural resources.

6. To improve local natural resource management plans and policies.
7. To 'look after Country' in a culturally appropriate way.
8. To create opportunities for sharing knowledge and experience.

Please feel free to share any information or data that shows how you feel you have achieved 'personal, social, institutional or cultural objectives'.
(Optional) _____

2.1.4 Did you have another objective (not listed previously) when you first chose to participate in "Selected activity"? If so, please enter it in the text box and indicate its importance and how much has been achieved. (Optional)

1. Please specify the objective here (and answer sub questions A and B)

Please feel free to share any information or data that shows how you feel you have achieved this additional objective (Optional)

S2.2 How much of the following were available to support you when "Selected activity"?

How much was available?

0 = Nothing available at all; 5 = Everything I needed; I do not know; Available but I did not use

1. Family and friends' supportive attitude towards the activity.
2. Community's supportive attitude towards the activity.
3. Evidence that the actions work.
4. Previous personal experience with this type of activity.
5. Knowledge/advice from Aboriginal and Torres Strait Islander people or organisations.
6. Local knowledge, experience, or advice about how to undertake this activity (e.g. from friends, family, neighbours, and nearby landowners).
7. Advice/information from people outside the local community (e.g. agronomists, agricultural extension officers, researchers, and other scientists).
8. Information from threatened species plans, regional natural resource management plans, or other relevant plans/documents.
9. Financial incentives linked to the activity's outputs/outcomes (e.g. payments for carbon, ecosystem services).
10. Ongoing security of external funds for undertaking the activity (i.e. rather than short-term funding).
11. Compensation payments (e.g. for lost potential income, opportunity costs).
12. Funds to help with the cost of materials/equipment to undertake the activity.
13. Assistance with the paperwork required to apply for funding.
14. Assistance with other administrative work required to participate in the activity.
15. Supportive and effective leadership/management of the activity.
16. Additional labour to undertake the activity.
17. Other resources to undertake the activity (e.g. plants, fencing).
18. Time to plan for and prepare before undertaking the activity.

S2.3 Did any of the following additional factors help or hinder when "Selected activity"? - If this did not occur while you were undertaking the activity, or if it is not relevant, then please leave response as "NA"

NA; -5 = Significant hindrance; 0 = Neutral or no impact; 5 = Significant help

1. 'Life events' – affecting the amount of time you could spend on the activity.
2. Changes in government policies or processes relating to natural resource management.
3. Changes in income (on farm or otherwise).
4. Changes in costs (on farm or elsewhere).
5. Extreme temperatures (e.g. heat waves or cold snaps/frost).
6. Wildfire(s).
7. Flood(s).
8. Drought(s).
9. Storm(s) or Cyclone(s).
10. Landslide(s).
11. Invasion by weeds.
12. Predation by feral animals.
13. COVID-19.
14. Changes to machinery and equipment.
15. Changes to property infrastructure (e.g. storage for equipment, fencing, sheds).
16. Changes in communications and technology.
17. Other things that helped or hindered (please specify).

S2.4 In your own opinion, what helped most when [Selected activity]?

S2.5 In your own opinion, what hindered most when [Selected activity]?

S2.6 What was your overall experience [Selected activity]?

Likert scale. “-5 = Very negative; 0 = Neutral; +5 = Very positive” and “☐ Not applicable

S2.7 Would you participate in any of the following activities in the future?

Likert scale. “-5 = Definitely no; 0 = Neutral; +5 = Definitely yes” and “☐ Not applicable

The same activity, i.e. [Selected activity].

A different natural resource management -focused activity.

S2.8 Do you have any comments or suggestions to help improve outcomes from activities like this?

.....

Section 3

[Display S3.1 if Coordinator, Expert advisor, Project/department manager, Fund manager is selected as primary role in Q3.2, otherwise skip to S3.3]

S3.1 Please indicate how much you agree or disagree with the following statements.

-5 = Completely disagree; 0 = Neutral; 5 = Completely agree

1. Stakeholders are actively engaged in planning and/or decision-making processes.
2. Everyone's roles and responsibilities are clearly defined in an understandable manner.
3. The decision-making processes are well-structured and transparent.
4. Resources are allocated effectively to help achieve the program objectives.
5. People are willing to adapt to necessary changes.

S3.2 Role-specific open-ended questions (these will appear depending on how the respondent answered question S1.12 [In what capacity did you engage when])

a. As a coordinator, what are the main challenges you face when undertaking these types of natural resource management activities? How do you address them? (Optional) [appear when Coordinator selected as primary role]

b. Was there adequate community participation? If so, how involved was the community in this activity? (Optional)? [appear when Coordinator selected as primary role]

c. From your expert perspective, what are the main challenges facing the teams you provide advice to and what improvements would you recommend? (Optional) [appear when Expert Advisor selected as primary role]

d. How do you measure the effectiveness of the activities you manage in terms of achieving their stated goals? (Optional)

[appear when Project, department or fund manager is selected as primary role]

e. How are funds delivered to the conservation groups? Is it through regionally accredited natural resource management groups or any other means? (Optional) [appear when Project, department or fund manager is selected as primary role]

f. In your opinion, is there any conflicts between the different natural resource management groups that work to redress similar issues? If so, are any conflict resolution mechanisms in place for overcoming these conflicts? (Optional)

[appear when Coordinator, Project, department or fund manager selected as primary role]

QUESTIONS FOR ALL RESPONDENTS

Finally, we would like to collect some background information about you, so that we can describe the 'types' of people who have provided us with information without identifying or 'naming' anyone (e.g. describing where respondents live and their age).

1. What is the postcode of your primary residence?
Postcode: _____
2. How long have you been living in your current state or territory?
In years: _____
3. What is the highest level of education you have completed?

- ☐ Year 9 and below ☐ Year 10
☐ Year 11
☐ Year 12
☐ Certificate (I/II)
☐ Diploma or Certificate (III or IV)
☐ Undergraduate University Degree (e.g., BSc, BA)
☐ Postgraduate University Degree (e.g., MSc, Ph.D.)
☐ Others (e.g., professional qualification) (please specify) _____ ☐ Prefer not to answer
4. What is your gender?
- ☐ Male
☐ Female
☐ Non-binary
☐ Other (please specify) _____
☐ Prefer not to answer
5. Are you of Aboriginal or Torres Strait Islander origin?
- ☐ Yes ☐ No ☐ Prefer not to answer
6. How many people (including children, or other dependents) are in your household?
- Number of Adults _____
- Number of children (under 18 years) _____
7. Which of the following categories best represents your household's total income before tax?
- ☐ 1- \$299 a week / \$1-\$15,599 a year
☐ \$300-\$499 a week / \$15,600-\$25,999 a year
☐ \$500-\$649 a week / \$26,000-\$33,799 a year
☐ \$650-\$799 a week / \$33,800-\$41,599 a year
☐ \$800-\$999 a week / \$41,600-\$51,999 a year
☐ \$1000-\$1,249 a Week / \$52,000-\$64,999 a year
☐ \$1,250-\$1,499 a Week / \$65,000-\$77,999 a year
☐ \$1,500-\$1,749 a week /\$78,000-\$90,999 a year
☐ \$1,750-\$1,999 a week /\$91,000-\$103,999 a year
☐ \$2,000-\$2,499 a week /\$104,000-\$129,999 a year
☐ 2,500-\$3655 or more a week /\$130,000-\$190,000 a year
☐ \$3655 or more a week /\$190,000 or more a year
☐ Prefer not to answer
8. Is the primary source of property income on farm, off farm or approximately equally shared? [only appear for those respondents who selected "a. I am a land manager" to question P.1.]
- ☐ Primarily off-farm
☐ Primarily on-farm
☐ Approximately equal
9. What proportion of your income (roughly) goes towards paying off debts and expenses? (e.g., machinery loans, mortgages, car loans or credit cards). [only appear for those respondents who selected "a. I am a land manager" to question P.1.]
- _____

Survey Prize Draw

Thank you for completing this survey. Seven participants who complete the survey will be randomly selected to win one of the following prizes. There are two tickets available for both the National Landcare Conference and the Australian Citizen Science Association conference, there is one ticket available for each of the others

Please select the prize draw you would like to enter:

☐ NRM Knowledge Conference – Cairns, 8th–12th September, plus \$1,000 to support travel and accommodation ☐ National Landcare Conference – Gold Coast, 21st–24th September, plus \$1,000 to support travel and accommodation

☐ NFF Conference - AgXchange – Gold Coast, 23rd–25th September, plus \$1,000 to support travel and accommodation

☐ CSA Conference – Melbourne, 13th–15th October, plus \$1,000 to support travel and accommodation

☐ ESA Conference – (Awaiting details of date and location), plus \$1,000 to support travel and accommodation

Appendix A: Flyer used to recruit participants

SUCCESS FACTORS FOR RESILIENT LANDSCAPES



What helps or hinders your efforts to manage natural resources such as land, water, soil, plants and animals?

If you are a land manager or engaged in what we call 'natural resource management activities' (this includes a very broad range of actions, to restore or rehabilitate landscapes, to protect threatened species, to change agricultural practices for sustainable outcomes, or to otherwise improve and maintain natural resources) — we invite you to share your unique experiences and insights on what truly makes your efforts effective.

For over 30 years, research has provided valuable insights into the factors that drive or hinder success in natural resource management activities. But we know that true success is best defined by those directly involved in these efforts.

Help us learn from your experiences, achievements, or aspirations in these activities—whether you're actively engaged or have yet to start.

By contributing your personal experiences to this research, you can help improve future programs, make efforts more effective across diverse communities and environments, and support your own success.

What does participation involve?

- We hope participants will complete an online survey to collect 'baseline' information.
- After completing the survey, participants will also be asked if they would like to take part in an interview, allowing us to gain even deeper insights.
- Access the survey at:

bit.ly/linktosurveyinsert

Please enter this address in your desktop browser.
The survey is not suited for mobile devices.

To encourage participation, a total of **eight prizes** will be awarded. All winners (drawn randomly) will receive **free conference registration** and a **\$1,000 gift voucher** to support travel and accommodation.

Further information

Visit: nesplandscapes.edu.au/projects/nesp-rih/landcare-and-threatened-species

CONTACT A RESEARCHER:

Name: Amber Tsai, University of Tasmania
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Email: succeslandscapes@utas.edu.au

This research is being conducted by researchers at the University of Tasmania, the National Landcare Network, the NSW Department of Climate Change, Energy, the Environment and Water, and Western Sydney University, with support from the Resilient Landscapes Hub of the National Environmental Science Program.
This study has been approved by the University of Tasmania Human Research Ethics Committee (H0030924)



Appendix B: Outcomes with descriptions of related variables that monitoring resources could focus on, during different implementation periods

Table 6: Outcomes that are hardest and easiest to observe.

	Examples of outcomes that may be hard to observe (and where it might be sensible to concentrate most monitoring resources)	Examples of outcomes that may be easier to observe (and where it may be possible to ask NRM participants to self-assess)
Ecological outcomes	- reductions in greenhouse gas emissions - improvements in soil health - reductions in soil erosion - improvements in creek/wetland health - reductions in fire threats - protection of threatened species - protection of threatened ecological communities - increases in native perennial cover	- Improvements in remnant vegetation - Increases in native plant diversity - Increases in native animal diversity
Economic outcomes	- improvements in land values - opportunities to diversify property income - reductions in costs - opportunities to generate additional income - improvements in water security - improvements in livestock productivity - improvements in pasture/crop yield	
Social outcomes	- improvements in NRM policies and plans	- Looking after country the 'right' way - Having conservation efforts recognised - Building community capacity - Maintaining or improving health/wellbeing - Increasing community connections - Enhancing knowledge and experience - Creating knowledge sharing opportunities

Table 7: Outcomes that emerge quickly versus those that take time.

Examples of outcomes that may emerge relatively early (and which may provide early indicators of whether an activity is on track to achieve longer term ecological outcomes)		Examples of outcomes that may take a long time to emerge (suggesting projects should not be ‘shut down’ if outcomes are not quickly apparent)
Ecological outcomes	- reductions in fire threats - reductions in greenhouse gas emissions	- Improvements in remnant vegetation - Increases in native plant diversity - Increases in native animal diversity - improvements in soil health - reductions in soil erosion - improvements in creek/wetland health - protection of threatened species - protection of threatened ecological communities - increases in native perennial cover
Social outcomes (most strongly associated with ecological outcomes)	- Improvements in NRM policies and plans - Looking after country the ‘right’ way - Having conservation efforts recognised - Building community capacity - Maintaining or improving health/wellbeing - Increasing community connections - Enhancing knowledge and experience - Creating knowledge sharing opportunities	
Economic outcomes (associated with social and ecological outcomes)	- Improvements in land values - Opportunities to diversify property income - Reductions in costs - Opportunities to generate additional income - Improvements in water security - Improvements in livestock productivity - Improvements in pasture/crop yield	

Appendix C: Illustrative example of the types of variables that could be used when evaluating ‘success’

Table 8: Illustrative examples of the types of variables that could be used when evaluating activities with examples drawn from variables identified, through our analyses, as being associated with success.

Main Category	Description	Examples of Ecological Variables	Examples of Social Variables	Examples of Economic Variables
Context	Characteristics of the site and participants involved in the activity.	Vegetation cover, EPBC listed species Whether site is flood or fire affected	Age Gender Education	Hectares of land in different uses
	Characteristics of the wider region (e.g. postcode) in which the activity occurs\	Habitat condition Plant species richness Annual precipitation	Proportion of population with degree Population density	Average household incomes Proportion of population employed in Agriculture
Activity Characteristics and Implementation Experience	Overarching and supporting objectives	Ecological objectives	Social objectives (if any)	Economic objectives (if any)
	Type and scale of activity, and target outcomes and beneficiaries.	What is being done (e.g. planting trees) Hectares involved	Number, and type of people involved Roles of people (e.g., 2 paid coordinators, 3 private landholders)	Project costs/funding
	Activity specific support		Help with administration, or forming partnerships, access to information	Payments for ecosystem services, labour or equipment
	Unexpected Events that impact an activity	Droughts, floods, fires and other environmental shocks occurring during life of activity	Changes to government related (NRM) policy, ‘Life events’ (e.g., new child in family) Other (e.g., COVID)	Significant changes to the activity’s costs New equipment for monitoring or planting trees Increases in cost of living
Outcomes	Planned	Matched to objectives	Matched to objectives	Matched to objectives
	Additional outcomes (good or bad)	Not matched to objectives	Not matched to objectives	Not matched to objectives

Appendix D: Variables found to be associated with, or which help predict, different types of success

Table 9: Variables found to be associated with, or which help predict, different types of success.

General type of variables to consider	Specific examples of variables	Association with (perceptions of) different types of success	Association with intentions to remain engaged in the long term
Characteristics of people involved in activities	Age	Those over 60 years of age were more likely to report low levels of ecological and economic success than others	Those over 60 years were less likely to want to remain engaged in the same activity in the future
	Gender	Males were more apt to report higher perceptions of economic success than other respondents	Males were more likely to want to engage in a different activity in the future than others
	Education		Those with a degree or higher were more likely to want to remain engaged in either the same, or a different activity, in the future, than others
	Income		Those with an income > \$130k per annum were more likely to want to engage in a different activity in the future than others
	Roles and responsibilities	The groups of actors termed 'community volunteers' (as defined in section 5) scored ecological successes lower than institutional professionals	Property or project managers were less likely to want to engage in the same activity again; Community volunteers were more likely to want to engage in a different activity; volunteer coordinators were less likely
	Variety of participants	The entire NRM system works as an integrated system and relies on there being a variety of different 'actors', who contribute in different ways.	
Characteristics of the activities being undertaken	Types of activities (as defined in section 5)	Multi-site activities were generally considered to generate fewer economic successes than independent private land activities Activities that were either institutionally oriented were considered to generate greater social successes than independent private land activities	
	Variety of activities	The entire NRM system works as an integrated system and relies on their being a variety of different 'activities', focused on different but related outcomes.	
	Years since started	Almost all ecological outcomes take years to emerge Economic outcomes can also be slow to emerge. Length activity was positively associated with perceptions of social success	
	Social Enablers	Social enablers were positively associated with perceptions of social success	Those who, on average, rated the availability of social enablers at > 3.8 were much more likely to be willing to engage in future NRM activities than others
	Economic Enablers	Economic enablers were positively associated with perceptions of both economic and social success	
	Unexpected events	Respondents who reported that their activities had been negatively impacted by unexpected environmental 'events', reported fewer ecological 'successes'.	Respondents who reported very few unexpected environmental 'events' that impacted activities were more likely to be willing to engage in the same activity again, than those having either very disruptive or very helpful environmental events

General type of variables to consider	Specific examples of variables	Association with (perceptions of) different types of success	Association with intentions to remain engaged in the long term
	Social Events/changes		Those experiencing unexpected social events that helped activities were more likely to be willing to engage in either the same or a different future activity than others
	Economic Events/changes	Respondents who reported that their activities had been impacted by positive unexpected economic events (e.g., improvements in technology, reductions in cost) also reported higher perceptions of social successes.	Those experiencing unexpected economic events that positively impacted activities (and/or an absence of negative economic events) were more willing to engage in the same activity again than others
Social-ecological context	Social context	Those undertaking activities in the most rural/remote and socioeconomically disadvantaged regions perceived lower levels of social and economic successes than those undertaking activities in the most urban areas	Those who had previously undertaken projects in the most urban and socioeconomically advantaged regions were more likely to be willing to engage in the same NRM activity again than others.
	Ecological context	Those undertaking activities in the second least intact ecological regions perceived higher levels of ecological successes than those undertaking activities in the least intact regions	Those who had previously undertaken projects in the least intact ecological regions were more likely to be willing to engage in the same activity than others. Those who had previously undertaken projects in the most intact ecological regions were less likely to be willing to engage in a different activity than others.
	Interactive context		Those who had previously undertaken projects in areas where the dominant land uses are agriculture and conservation were more likely to be willing to engage in a different activity than others
Outcomes	Perceptions of overall success	Not tested	Those who felt they had mostly or completely achieved their activity's primary objective were more likely to be willing to participate in the same activity again.

Appendix E: Location of planned outputs from project proposal

Output ID	Outputs ID and Description	Research User	Location of output
#1	#1 questionnaire(s) and a national dataset that contains consistently measured variables describing Landcare projects and the programs and regions in which they operate	NLN; peak state and territory Landcare bodies	See Appendix A
#2	#2 list of national-scale indicators and recommendations about variables that could be regularly measured and reported on to make visible the various successes of Landcare programs;	NLN; peak state and territory Landcare bodies	Section 9.1 (see also Table 6, Table 7 and Table 9) - noting that this report provides and illustrative examples only. Much other work would need to be done to develop and test a 'whole of system' framework that is practical, and that provides meaningful, timely data for all of the diverse actors and organisations so critical to successful NRM in a complex and connected system
#3	#3 list of the types of projects (activities) and project objectives that are likely to generate synergistic outcomes	NLN; peak state and territory Landcare bodies	Section 5 (specifically Figure 13 and Figure 12) Section 0 (Table 5)
#4	#4 Other bespoke project outputs relevant to the NLN and peak state and territory Landcare bodies will be codesigned during the project but are likely to include things such as maps and/or factsheets focused on issues of specific importance to these groups.	NLN; peak state and territory Landcare bodies -	In addition to regular meetings (recorded in the regular milestone reports), Bassie Limenih presented some preliminary findings at the 2025 National Landcare Conference at the, Gold Coast: What success means in natural-resource management across Australia, September 2025 (Bassie Limenih). Natalie Stoeckl also gave an on-line presentation, with more updated results, to the NLN membership meeting, 25 May 2026
#5	#5 Bespoke project outputs for recovery teams will be codesigned during the project but may include lists of indicators that could be monitored and reported on or lists of projects that are likely to generate synergistic outcomes. Other outputs may include things such as maps and/or factsheets/policy briefs focused on issues of specific importance to this group.	DCCEEW / Biodiversity Division / Protected Species and Ecological Communities Branch / Recovery Teams and state and territory counterparts	Section 0 (Table 6, Table 7 and Table 9), wrap up factsheet
#6	(TBC) – regular meetings (with presentations) with Kate Andrews and Sarah Hoyle; also	NRM Regions Australia	Meetings recorded in project milestone reports; all publications shared with Kate Andrews and Sarah Hoyle before submission to journals

Output ID	Outputs ID and Description	Research User	Location of output
	sharing publications before submission; factsheet at end		
#6	#6 conceptual model that synthesises findings from previous research about factors that influence the ecological, social and/or economic outcomes of Landcare and recovery-team projects (or similar community-based programs – could be produced as a stand-alone item or published within articles, report, or factsheets) – co-created with Project 1.4.	(Additional outputs)	A high level conceptual model showing the ‘pathway to success’ was published in Limenih et al. (2026) – see section 3. The conceptual model presented in Figure 1, blends insights from Limenih et al’s model with those of our partners, and more specifically describes the types of variables thought to influence ‘success’.
#7	#7 national-scale database with regional summaries of Landcare and threatened-species recovery-team projects, alongside information about the socioeconomic and biophysical characteristics of the regions in which teams operate.	(Additional outputs)	Human ethics prevents us from being able to release the ‘raw’ survey data. We explored options to provide summary data at the postcode level, but there were too few observations within each individual postcode for us to ensure complete confidentiality of respondents (the ABS, for example, will not release small area data, if there are a very small number of respondents). Similarly for NRM Regions: respondents reported on activities undertaken across 47 different regions, but the number of observations per NRM region was too small to be able to guarantee confidentiality if releasing information. Section 4.3 therefore provides descriptive statistics from core data collected through the on-line survey, with the subsequent sections presenting results from more sophisticated analysis of data.
#8	#8 scientific publications, consolidated report, factsheets.	(Additional outputs)	<u>Journal Articles - Published</u> - Limenih, B., Stoeckl, N.; Larson, S. Tsai, A., Adams, V., Dean, A. (2025), Pathways from Socioeconomic Values to Natural Resource Management Practices to Ecological Change: A Systematic Review, Biological Conservation, https://doi.org/10.1016/j.biocon.2025.111630 (output publication number 1.4-03) - Stoeckl, N., Costanza, R., Dorji, N., Kubiszewski, I., Limenih, B., Tian, J., Yamazaki, S., (2025), Valuing the reciprocating services that humans can provide to ecosystems, Ecological Indicators https://doi.org/10.1016/j.ecolind.2025.113496 (output publication numbers 4.10 – 02 and 1.4-02) <u>Journal Articles – In review</u> - Amber CY Tsai, Natalie Stoeckl, Bassie Yizengaw Limenih, Silva Larson, Vanessa M. Adams (in review), Complementary roles in natural resource management: Linking actor groups and activity types (output publication number 1.4-03) - Bassie Yizengaw Limenih, Natalie Stoeckl, Amber C.Y. Tsai, Silva Larson, Vanessa M. Adams (in review), Rethinking ways to Demonstrate Success in Natural Resource Management: Towards Multidimensional and Tiered Monitoring Systems (output publication number 1.4-03) - Silva Larson, Natalie Stoeckl, Bassie Yizengaw Limenih, Amber CY Tsai (in review), Beyond motivation: Context, experiences and outcomes influence sustained engagement in natural resource management (output publication number 1.4-03) <u>Journal Articles – In preparation (aiming to submit before end of 2026)</u>

Output ID	Outputs ID and Description	Research User	Location of output
			- Bassie Yizengaw Limenih, Natalie Stoeckl, Amber C.Y. Tsai, Silva Larson, Vanessa M. Adams (in prep), Factors Affecting Success in Natural Resource Management Activities: Perception Latency, Overall, Success, and Multidimensional Success - Amber CY Tsai, Natalie Stoeckl, Alistair Thompson, Bassie Yizengaw Limenih, Silva Larson, Vanessa M. Adams (in prep), Are we monitoring what matters? A context-based framework for connecting evidence in natural resource management (RELATED publication from project 1.4)

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