A missing piece of the puzzle of on-farm freshwater restoration: What motivates land managers to record and report land management actions?

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ABSTRACT. Worldwide, progress has been made toward managing productive lands more sustainably to improve freshwater health. However, a lack of national guidance for environmental reporting and recording means that it is not possible to quantify consistently which land management actions that help improve water quality have been implemented, where, when, and to what extent. This situation suggests that information on the effectiveness of these actions is missing or fragmented. Systematic recording and reporting of land management actions is an important piece of a large freshwater restoration puzzle. We investigated what motivates New Zealand land managers to record their actions and report them to their networks by conducting 23 semi-structured interviews. Between February and November 2020, we spoke with food producers, New Zealand Indigenous people of the land tāngata whenua community members, and government and industry representatives. The key themes that described motivators for these land managers to record and report land management actions were collective engagement (e.g., working with catchment care groups), identity and social norms (e.g., being a “socially approved” farmer), and efficient farm management (e.g., using one simple recording tool for multiple purposes to save time). While these findings will be broadly germane to international contexts, they are being used specifically to inform the development of a proposed National Register of Land Management Actions in Aotearoa New Zealand.

Key Words: agriculture; catchment groups; ecosystem; freshwater; land management; land use actions; monitoring; motivations; recording; reporting; restoration

INTRODUCTION

Globally, pressures have never been greater for land managers to practice integrated land management that supports healthy people, a healthy environment, and a healthy return on investment. The impacts of agricultural production on the health of freshwater environments are well recognized, especially high concentrations of nutrients and sediment (Allan 2004, Food and Agriculture Organization 2016, Clark and Tilman 2017, Mateo-Sagasta et al. 2017). Changes to environmental legislation such as New Zealand’s National Policy Statement for Freshwater Management (NZ Ministry for the Environment 2020), Australia’s Queensland Government’s Reef 2050 Water Quality Improvement Plan (https://www.reefplan.qld.gov.au), and the UK’s Environment Bill 2020 (Department for Environment, Food, and Rural Affairs 2022) reflect the impacts that agricultural production has had on freshwater ecosystem health. These legislative changes, along with increasing public awareness (e.g., Stats NZ - Tatauranga Aotearoa 2018, Rousseau and Deschacht 2020), have created significant expectations for land managers to move toward holistic land management actions. These actions most commonly include fencing of land adjacent to waterways, stock exclusion from waterways, vegetated buffer strips or plantings, riparian management plans, and construction of artificial and natural seepage wetlands (Doehring et al. 2020).

Although recognized techniques exist to record and report some of these actions (e.g., decision support tools for the management of grazing and crop practices), an overall lack of standardized recording methods means that there are large inconsistencies in how actions are recorded (e.g., ranging from paper records to photographs and digital recording). These inconsistencies result in the inability to determine accurately which land management actions have the greatest effect on water quality outcomes (Filoso and Palmer 2011, Pander and Geist 2013), making the effectiveness of freshwater restoration efforts difficult to assess (Doehring et al. 2020). This situation is particularly the case where many different yet contributing actions need to be evaluated, all while separating impacts caused by climate change and natural influences.

The jigsaw puzzle of improving water quality

The process of improving water quality is comparable to completing a jigsaw puzzle with critical pieces of knowledge missing (Fig. 1). There are three pieces of information to the puzzle, two of which are commonly done and reasonably well understood: the type of water quality actions that land managers implement, and the state and trends of water quality. Freshwater quality information, in particular, is commonly recorded and reported, contributing detailed pieces of information to the complex restoration puzzle. For example, water quality is collected at > 1500 river monitoring sites in New Zealand (https://www.lawa.org.nz) and at > 13,000 sites in Germany (Arle et al. 2016).

However, although the state and trends of freshwater quality are generally well understood, just measuring outcomes (e.g., water quality) without simultaneously quantifying actions (e.g., 98% of stock excluded from riverbanks) leads to an inability to evaluate accurately which actions are most effective and why (Fig. 1). This situation describes the third (missing) piece of the puzzle: the systematic recording and reporting of what type of land management actions have been done, where, and to what extent. Although multiple open access databases exist that allow the recording and reporting of a variety of restoration action data worldwide (e.g., Atlas of Living Australia, https://www.ala.org, 4Cawthron Institute, Nelson, New Zealand, 2Department of Science Communication, University of Otago, Dunedin, New Zealand, 3Graduate School of the Environment, Centre for Alternative Technology, Machynlleth, Wales, 4Happen Consulting, Christchurch, New Zealand
The need for this research

There is a multitude of complexities associated with systematically quantifying actions, including high costs, privacy and confidentiality issues, lack of standardized methods, variability of data quality due to multiple spatial scales, and the lag effects of management actions (Doehring et al. 2020). To address some of these challenges, the New Zealand government funded a study to develop a National Register of Land Management Actions, which will provide a much-needed repository tool, capturing consistent information within a centralized “data warehouse” that brings together data from various platforms (https://ourlandandwater.nz/incentives-for-change/national-register-of-actions/). Although our findings specifically inform the development of this National Register in New Zealand, the insights gained are widely applicable in international contexts.

Any data reporting platform is only as good as the information it contains. For the purposes of catchment management, that
information must be available for sharing with others. We use the term “recording” to refer to any collection of information on land management actions that influence water quality (e.g., written notes, photographs, existing databases) and the term “reporting” to refer to any form of information and knowledge sharing (e.g., social media, any form of oral communication, industry-specific reporting platforms). For any data recording and reporting platform to be successful, land managers must be sufficiently motivated and empowered to participate in the platform. Substantial research efforts have assessed the efficacy of innovative smart technologies for farm management (e.g., decision-support tools, variable-rate irrigation; Grober and Grober 2020), and the adoption of new management practices and tools (e.g., Ahnström et al. 2009, Heath 2011, Brown and Roper 2017, Rust et al. 2021). Substantial research has also been done on the social theoretical aspects of adoption of innovations in agriculture (Montes de Oca Munguia et al. 2021), including the “model of contagion” whereby people adopt new practices when they come into contact with others who have already adopted the practices (Young 2009). However, there are still considerable knowledge gaps around the roles of socio-psychological variables (e.g., attitudes, social pressures; behavioral, cultural, economic, and regulatory barriers) in motivating land managers to record and report their actions. Our research aims to address this gap by informing the implementation of an effective national register through exploring such socio-psychological aspects.

Responsible environmental behavior as theoretical framework

We regard any actions that improve water quality, including systematic recording and reporting, as pro-environmental behavior, which can be referred to as any behavior that “harms the environment as little as possible, or even benefits the environment” (Steg and Vlek 2009:309). Pro-environmental behavior is directed toward and performed with the intention of promoting the welfare of others (Ramus and Killmer 2007). Acting for the benefit of others contributes to intrinsic satisfaction, which drives pro-social motivation and behavior (Caprara and Steca 2007, Grant 2008, Greiner and Gregg 2011). It is not well understood which variables are most influential in motivating individuals or groups to take responsible environmental action (Tabernero and Hernández 2012). Our study addresses this gap by exploring motivational variables that affect pro-environmental behavior in the New Zealand context, under the theoretical framework of the model of responsible environmental behavior (Hines et al. 1987). This model was developed based on an analysis of 128 empirical studies in environmental behavior that found that an individual’s intention to act in an environmentally responsible manner depends on a composition of six cognitive and personality variables. Here, we list these variables in the context of landowners’ intentions to record and report.

1. Knowledge of issues: Any factors pertaining to knowledge of the environment or aspects of environmental problems and their consequences. In our context, this variable means that land managers with greater knowledge of environmental issues would be more likely to record and report land management actions than land managers who are not aware of any issues.

2. Knowledge of action strategies: This variable is closely linked to variable 1, whereby land managers with knowledge on how to take action on freshwater degradation are more likely to record and report land management actions because they are more likely to understand the connections between recording and reporting and freshwater restoration.

3. Locus of control: Represents an individual’s perception of whether he or she can bring about change through his or her own behavior (internal locus of control), as opposed to the belief that change occurs through chance or powerful others such as government (external locus of control). In our context, land managers who have an internal locus of control would be more likely to record and report land management actions.

4. Attitude-behavior relationship: The general attitude of an individual, and an individual’s feelings toward recording and reporting land management actions, whereby land managers with more positive attitudes toward recording and reporting are more likely to engage in the process.

5. Verbal or written commitment: An expressed intention to act upon a pro-environmental action. Thus, land managers who commit to recording and reporting land management actions, either verbally or in written form, are more likely to do so than land managers who do not commit.

6. Individual sense of responsibility: An individual’s feelings of duty or obligation to portray pro-environmental behavior. In our context, land managers who feel some degree of personal responsibility toward the environment are more likely to engage in pro-environmental behavior than land managers who hold no such feelings.

We think that the empirical application of the responsible environmental behavior model is well suited for our research. We were interested to determine whether the six variables could be applied as determinants of increasing land manager’s intentions to record and report land management actions in our context.

METHODS

Twenty-three in-depth, semi-structured interviews were conducted between February and November 2020. Interviewees were targeted leaders whom we categorized into the following five stakeholder groups: (1) public or community, (2) Indigenous people of the land or tāngata whenua, (3) government, (4) a range of primary industry sector bodies, and (5) food and fiber producers (Table 1). Industry sector bodies and producers (including agricultural organizations and farmers) will be the primary data providers for the Register of Actions and therefore comprised 12 of the 23 interviewees. Members of the other three stakeholder groups are also likely to provide data or to use the register to inform their catchment management actions; these 11 interviewees were included to explore the perspectives of a range of potential register users. A purposive, snowball sampling approach (Corbett 2005, Robson 2011) was used to identify and select key individuals covering the range of stakeholder types. Participants were selected based on their leading roles in and extensive knowledge of agricultural knowledge extension. Their combined experience provided in-depth expert advice on the topic of recording and reporting land management actions. This study was approved by the University of Otago’s Human Ethics Committee (D20/03).
Table 1. Interviewees (N = 23) represented five stakeholder groups.

| Stakeholder                      | N  | Identifier | Affiliation                                | Responsibility      | Area of expertise |
|----------------------------------|----|------------|--------------------------------------------|---------------------|-------------------|
| Public or community              | 3  | Comm1      | Nongovernmental organization               | Managerial          | Environment       |
|                                  |    | Comm2      | Nongovernmental organization               | Managerial          | Environment and policy |
|                                  |    | Comm3      | River catchment care group                 | Active member       |                   |
| Indigenous people of the land    | 2  | TW1        | Māori agribusiness                         | Managerial          | All areas         |
| fāngata whemua                   |    | TW2        | Ngāi Te Rauhikihiki ki Taumutu, Te Taumutu Rūnanga | Governor and member | Māhinga kai practitioner |
| Government                       | 6  | Gov1       | Regional council                           | Managerial          | Environment and policy |
|                                  |    | Gov2       | New Zealand Department of Conservation     | Managerial          | Freshwater        |
|                                  |    | Gov3       | New Zealand Department of Conservation     | Leadership          | Environment and extension |
|                                  |    | Gov4       | New Zealand Ministry for the Environment   | Managerial          | Policy            |
|                                  |    | Gov5       | New Zealand Ministry for Primary Industries | Leadership          | Environment       |
|                                  |    | Gov6       | New Zealand Landcare Trust                | Leadership          | Environment and extension |
| Industry sector bodies           | 7  | Ind1       | New Zealand Beef and Lamb                  | Managerial          | Environment and extension |
|                                  |    | Ind2       | Dairy NZ                                  | Managerial          | Environment and extension |
|                                  |    | Ind3       | Dairy NZ                                  | Leadership          | Environment and extension |
|                                  |    | Ind4       | Fertilizer association                     | Managerial          | All areas         |
|                                  |    | Ind5       | Forestry, regional                         | Managerial          | Environment       |
|                                  |    | Ind6       | Horticulture NZ                            | Leadership          | Environment and policy |
|                                  |    | Ind7       | Forestry, national                         | Managerial          | All areas         |
| Producers                        | 5  | Prod1      | Sheep and beef                            | Farmer              |                   |
|                                  |    | Prod2      | Mixed (deer, sheep, and beef)              | Farmer              |                   |
|                                  |    | Prod3      | Mixed (dairy, arable)                      | Farmer              |                   |
|                                  |    | Prod4      | Sheep and beef                            | Farmer              |                   |
|                                  |    | Prod5      | Dairy                                     | Farmer              |                   |

Interview protocol

Two different sets of interview questions were developed to allow for targeted questioning of industry sector data providers and potential register users (Appendix 1). The interview schedule was piloted with one rural community member and one national industry sector representative to test question wording, clarity, sequencing, and length of interviews. Semi-structured interviews provide consistency across interviews yet allow deviation from the plan to follow the natural flow of conversation and to explore other ideas (O’Leary 2005). This form of interviewing allows a conversational approach with open-ended questions used as prompts (Brinkmann and Kvale 2015). We used questions such as “What are the advantages that you foresee with sharing management data?” and “How would you like to see your data shared?” In addition, land managers were asked to show photographs of the land they own or manage where land management actions have been applied to help improve water quality (Appendix 1). This method of photo elicitation, also known as “photo voice” (Wang and Burris 1997, Maclean and Woodward 2013), is a participatory approach that assists with “breaking the ice” between interviewer and participants and helps participants to talk about specific aspects of their land management actions.

Data collection and analysis

Interviews ranged from 38 to 80 min, with an average length of 61 min. Interviews were recorded using a handheld voice-recorder and transcribed verbatim, with a one-page summary of the interview sent back to participants to check the accuracy of the summary interpretation. Transcripts were coded using thematic content analysis following six phases described by Braun and Clarke (2006): familiarizing with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and reporting. Based on the number of times a theme was mentioned in conjunction with motivation to record and report, themes were ranked from most to least frequently mentioned. Six themes were identified, coded, and analyzed, reflecting the content of the entire data set. Of the six themes, detailed and nuanced analyses were conducted for the three most frequently mentioned themes across all stakeholder groups. This method applies the principle of “thick description” (Holliday 2002), which recognizes the strength of “going deeper” in the analysis to find the meaning and intentions of an interview, rather than reporting “shallow” results from a large number of interviews. Also described as a “latent” level of thematic analysis, we produced word trees from the interviews and used them to examine some of the underlying ideas, assumptions, and conceptualizations shaping the semantic content of these three themes.

The development of a validated and robust coding manual involved an iterative process in which drafts were refined and then tested by an independent researcher (Lombard et al. 2002, Neuendorf 2017). A total of 20% of the interview transcripts were tested for inter-rater agreement, calculated as Cohen’s kappa and percentage agreement. The final agreement was Cohen’s kappa of 0.523, with a percentage agreement of 97%, which was considered sufficient to validate the robustness of the coding manual (Lombard et al. 2002). All data handling was done in NVivo 12 (QSR International 1999).

RESULTS AND DISCUSSION

Recording and sharing knowledge is not a new practice for land managers

Our participants agreed that sharing knowledge on farm management was important to them and within their communities: 22 of 23 interviewees stated that they were willing to report land management actions to the wider public and their communities. If you’re not willing to share, then you are usually not willing to learn. - Prod1

I think for me, we’ve got nothing to hide and only lots to learn. - Prod3
In terms of recording, 20 of 23 participants indicated that they recorded actions for the overall management of their land. Such records included those for pest control (e.g., “There is accurate data on the trapping. [We] keep good records of how many mice and stoats [we catch] and that’s quite good.” - Comm3), water quality monitoring (“We are actually recording a lot of the stuff we’re doing, particularly around water quality.” - Prod2), and the monitoring of wider farm management processes (“All our stock numbers are recorded through systems.” - TW1). The importance of monitoring land management actions was generally well understood among land managers, highlighting that recording and reporting information is not new to them.

Producers and catchment community groups are already subject to a range of reporting requirements, resulting in complex workloads as part of their day-to-day land management. Understanding this fact is critical for the successful adoption of new farm management requirements. To support the successful implementation of new recording and reporting platforms, the situation of land managers needs to be understood and respected, and thoughtful considerations need to be given about how new tasks can be incorporated into existing monitoring systems. The risks of monitoring for the “sake of monitoring” are real, thereby losing sight of the overarching goal of sustainable land management.

You’ve got to really be careful you don’t end up getting too side-tracked [with recording]. Who’s going to use this stuff and what’s the expected outcome? That’s got to be in your mind the whole time, otherwise you could end up wasting your time. - Comm3

To be fair, most farmers just want to get out in the sun and get on with it and enjoy themselves. We don’t really like sitting around collating data. - Prod4

When personal information is recorded and reported on public interfaces, the topic of privacy and confidentiality needs to be considered. All but one participant indicated that they agreed to share their information with the wider public, and another participant agreed to do so after data stewardship and confidentiality was ensured. Privacy concerns were raised by three governmental stakeholders, one industry sector body stakeholder, and one community stakeholder.

But I couldn’t see companies releasing [private] information to your register because that would be contravening any privacy obligations. - Ind1

[If] they don’t need to disclose [private] information, then people are more confident or comfortable [to record and report] because there’s that balance of retaining their private information. - Comm5

Concerns around disclosing financial information was mentioned as a barrier to recording and reporting by one producer (“You wouldn’t want financial data out there though?” - Prod2). Understanding and responding to concerns about confidentiality and data stewardship is a fundamental part of this research. It needs to be upheld by clearly outlining and adhering to confidentiality requirements of those who produce the information. For example, although information might be collected at a farm level, it would be anonymized and summarized at a catchment level when publicly shared through potential data reporting platforms (e.g., Land Air Water Aotearoa, https://www.lawa.org.nz).

Inconsistent measurement of land management actions
To measure the nature of change, direction, and rates of change in restoration, information on land management actions needs to be recorded and reported in a consistent way and on a recurring basis.

And like any business, you need to know your infrastructure, you need to know your foundations as a business. That will take some time. [T]o really be able [for farmers] to manage [their land], and then monitor it and collect data against it that is actually useful, is going to take a step change in how we do things, and we’re going to have to really emphasize [...] that they must record, and they must report. - Ind1

Although most land managers were willing to record and share their information on land management actions, our results showed large inconsistencies in the detail and type of recording. This variation was related to the different purposes of recording and reporting (i.e., water quality actions vs. broader ecosystem restoration), but also to specific monitoring requirements imposed by regulatory authorities or funding bodies.

We’re accountable for delivering on outcomes, especially with regards to certain funding streams. We have certain KPI’s [key performance indicators] that we’re supposed to be delivering on, so it helps show progress towards those as well, and can show that they were worth investing in from the perspective of Treasury, for example. - Gov2

Participants noted that specific programs such as erosion control programs (e.g., the Hawkes Bay Erosion Control Programme in New Zealand) require land managers to fill in very detailed information on project databases, such as the number of poplar poles planted or the type of debris dams built. One interviewee is part of a catchment care group that records and reports information that is particularly relevant to them and their intended outcomes, such as volunteer hours spent in the field, number of field days in the catchment, and number of plants planted. Another interviewee who is part of a community group mentioned that they recorded length of planting done because it is more relevant for their restoration program. This inconsistency in recording and reporting means that land managers are unable to compare their efforts with those of their peers, both within their own catchments or at a national scale. This situation makes it difficult to learn from their successes and, importantly, from their less successful actions.

We’ve got to [record] because otherwise you just lose control. [I]f you’ve got one farm doing this and another one doing that, there’s just no way you can keep track. [...] So, we’ve got to have simple tools that actually collect the same data, otherwise you just go round and round in circles. - TW1

Lack of tools for standardized recording and reporting of land management actions
Systematically recording and reporting land management actions that help to improve water quality are critical steps toward being
able to link restoration actions with freshwater quality outcomes (Gilvear and Casas-Mulet 2008, Tomer et al. 2014, Parliamentary Commissioner for the Environment 2019). Consistent recording is more likely if information is either collected within one tool or the data collected across tools are the same. Our results showed, however, that land management action data in New Zealand are currently recorded and reported through a wide variety of tools by different stakeholders (Table 2), many of which do not collect the same type of information. These tools included: (1) holistic farm management apps for recording a wide range of information on farm management (e.g., mapping of paddocks retired for winter grazing), (2) farm assurance templates (e.g., for recording animal welfare), (3) industry-specific environmental planning tools (e.g., for recording erosion control measures), (4) nutrient or fertilizer management tools (e.g., for recording fertilizer applications), (5) financial reporting tools (e.g., for recording of monthly expenses), and (6) their own databases (e.g., spreadsheets; Table 2).

The types of recording and reporting platforms used were largely dictated by the type of land use (i.e., dairy, red meat, horticulture), the region where the land managers were based, and the environmental programs their council ran. Different recording tools were also used within the same industry. For example, dairy farmers who are Fonterra[1] shareholders used its sustainable dairying program “Tiaki” (https://www.fonterra.com/nz/en/campaign/tiaki.html), whereas dairy farmers who provide milk to Synlait Milk[2] used its best practice dairy farming program “Lead with Pride” (https://www.synlait.com/our-milk/). While both programs aim to maintain and improve on-farm water quality, the information that is required to be entered by land managers can differ greatly because it is specific to the companies that require the information.

Despite this large variety of recording and reporting tools and platforms, we found that photographs were the most used method for recording and reporting land management actions across interviewees. Imagery or photographs were mentioned by all 23 interviewees when discussing suitable methodology for recording and reporting land management actions. Photographs are an effective and efficient way to record land management actions, especially because most land managers have access to cameras as part of their day-to-day digital devices such as mobile phones.  

### Table 2. Types of recording systems and platforms used by the interviewed cohort. Numbers in brackets indicate the number of times a specific tool was used.

| Public or community | Indigenous people of the land Tāngata whenua | Government | Industry sector bodies | Producers |
|---------------------|---------------------------------------------|------------|------------------------|-----------|
| Own databases (2)   | Precision Farming Dashboard (1)             | Specific evaluation frameworks of national programs (1) | Own database (1) | Own databases, paper maps, digital portable devices (phone or tablet) (1) |
| Not required to record (1) | Unknown (1) | Regional monitoring programs (e.g., Sediment Erosion Control) (1) | Farm management system targeted at specific risks such as nutrients or fertilizer (e.g., Minda Land and Feed, Overseer) (2) | Farm management system or app targeted at broad farm management (e.g., Resolution, Farm IQ, Tiaki [Fonterra]) (3) |
|                      | Spatial mapping (1)                        | Legislation or national environmental standards (2) | Land and environment plans (e.g., farm environment plans) (2) | Specific farm assurance programs (e.g., NZ Red Meat Profit Partnership) (1) |
|                      | Surveys at varying intervals (1)           |                |                        |           |
|                      | Do not record (2)                          |                |                        |           |

Although it might be useful to assess progress based on a photograph taken on a farmer's device, the strength of any given photograph lies with the details that are recorded along with the image. For example, details could include the date and time the photograph was taken, GPS location, reason why the action was done (e.g., stock exclusion to reduce critical source areas), details about the land management action (e.g., length of fencing, number of plants planted), and any other metadata to add value to the information collected (e.g., name of the person who took the photo or details of materials used for stock exclusion). Without such information, a photograph loses value and suitability as a practical recording technique. We observed variability in the quantity and quality of the photographs taken. Whereas some land managers, for example, captured a one-off community planting event, others took more detailed photographs of plant type, georeferenced the location of the plants planted, and applied an assessment method called “fixed-point photo” whereby a photograph is taken at regular intervals from the same location to assess progress (e.g., Hall 2002; https://www.landcare.org.nz/file/module-2-photopoints/open).

Being able to upload photographs or other land management indicators to document implementation progress of land management actions requires a suitable recording and reporting platform. Learning processes that incorporate interactive platforms and create collaborative partnerships have the potential to change behaviors by enabling people to learn continuously and collectively about the context in which they work within their wider networks (Coggan et al. 2021). Examples of such global collaborations include the SAI Platform, which enables > 150 agricultural stakeholders to exchange knowledge worldwide (https://saiplatform.org), and OpenET, which tackles environmental challenges through information sharing (Environmental Defense Fund, https://www.edf.org). When we asked how such an interactive platform could be set up, critical aspects mentioned were ease of data entry (“It’s got to be easy and quick to input the data. You don’t want to be spending hours doing it, and you want to know that it’s going to be useful.” - Comm3), functionality (“You decide what order [the data] go in.” - Prod2), and

#### Photos are the easiest and quickest way to record [actions]. It doesn’t involve a whole lot of paperwork and it tells a big story. - Comm3


consistency of information gathered (“[We need] to make sure that everyone is measuring the same thing.” - Comm3).

What motivates land managers to record and report?
Our cohort of land managers was willing to record and report land management actions. We probed whether there were certain drivers that would increase this willingness. Land management decisions can be influenced through various extrinsic mechanisms, including legal instruments, economic rewards, provision of advice, and collective actions (Yaffee and Wondolleck 2000). Our interviews documented that there is more to successful recording and reporting of land management actions than clear guidance as to what and how to record; the role of socio-psychological variables such as attitudes and social pressures were key motivators for land managers to record and report. Attitude, subjective norms, and perceived behavioral control have been shown to positively influence farmers’ intentions to adopt sustainable land management actions such as improved grassland management or riparian management (Fielding et al. 2005, Borges et al. 2014, Coggan et al. 2021). Our research builds and expands on this knowledge, focusing on the roles these social aspects and sense of identity have in motivating behaviors (Bandura 2002, Longnecker 2016) such as recording and reporting of land management actions.

Our thematic content analysis identified six overarching themes that motivated the recording and reporting of land management actions that improve water quality (Table 3). These themes resonated with five of the six cognitive and personality principles of our theoretical framework, which we discuss in the context of the responsible environmental behavior model (Hines et al. 1987).

Table 3. Themes identified from interviews and their relation to the model of environmental behavior (Hines et al. 1987).

| Theme from participant interviews | Relation to model of environmental behavior (reason for recording and reporting knowledge on land management actions) |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Collective engagement              | Member or part of a catchment group                                                                                  |
| Identity and social norms          | Desire to be a socially approved farmer and to be seen as such by others                                              |
| Efficient farm management          | It is quick and easy to do, with multiple business benefits                                                          |
| Legislative                        | Required by national and regional legislation                                                                        |
| Stewardship                        | Recognition of intergenerational responsibility                                                                    |
| Economic                           | It makes sense financially and reduces costs                                                                         |

Some themes were “top of mind” for certain stakeholders but not others (Fig. 2). For example, collective engagement, social norms, efficient farm management, stewardship, and economic reasons acted as motivators all types of stakeholder, whereas legislation was not specifically mentioned as a motivator for the public or community cohort (Fig. 2). Similarly, our findings suggest that the legislation, stewardship, and economic themes may involve stronger motivators to record and report for Indigenous people of the land than for non-Indigenous primary industry stakeholders. However, just because a theme was not (or not often) mentioned by a certain cohort does not mean it is not relevant for them. We considered this idea during our analysis and discuss its implications in the following sections.

We especially acknowledge the low number of participants in the Indigenous people of the land tāngata whenua category. Although we were interested to learn about the motivations and barriers to recording and reporting actions from the perspective of Indigenous people of the land tāngata whenua, we recognize that Indigenous knowledge should be recorded and shared by tāngata whenua themselves. Tāngata whenua researchers are conducting research as part of the National Register of Land Management Actions project (Ruha et al. 2021).

We examined, in depth, the three most frequently mentioned themes (i.e., mentioned by > 16 interviewees during interviews; Fig. 2). These themes are potentially useful principles for the successful implementation of new recording and reporting requirements and are key motivations shaping the missing piece of the freshwater restoration puzzle (Fig. 3).

Motivation principle 1: collective engagement
In our study, 18 of 23 interviewees mentioned collaboration and the principle of collective engagement as a key motivator to record and report land management actions (Fig. 2). We defined collective engagement as any form of action that is practiced by communities within and between catchments whereby the community is actively learning and working together through multiple interactions and mutual exchange of ideas and knowledge. Often, the goal of collective engagement is to solve a common issue or problem, in our case, poor water quality.

In river catchments, collective engagement is often practiced in the form of catchment (care) groups that seek to connect and act around an issue of mutual interest and concern (Socientize Consortium 2014, NZ Ministry for the Environment and Stats NZ 2020). The people who live within a catchment are the protagonists of these collectives and play an important role in shaping catchment communities.

People are the key common factor in literally all the catchments that we’re working within. - Gov3

Horticulture and forestry representatives were the only two industry stakeholders who did not mention collective engagement as a motivator. Because both primary industries have very well-specified and long-standing strategies to monitor land management, as well as well-established relationships within their own and across other primary industries in New Zealand, we expected this theme to be less frequently mentioned by them.

For tāngata whenua, collective engagement recognizes “the act of caring”, or Tikanga Tiaki and “the act of handed down knowledge and practices”, or Taonga Tuku. These two themes (or kete) were recognized as two of four major themes or kete in a literature review by Ruha et al. (2021), who looked at identifying land-based actions to improve water quality. These themes emphasize the importance of connectedness through collective engagement as part of the “te ao māori” worldview. Our findings suggest that these principles may be monitoring motivators across cultures, and we encourage further research on this topic.

Social learning through collective engagement has resulted in an increased uptake of land management actions that improve water quality at catchment scales (Blackstock et al. 2010, Phillips et al. 2010, Reed et al. 2010, Barnett 2014), and our results support this idea.
Fig. 2. Motivations to record and report land management actions, from the most frequently mentioned theme (left) to the least mentioned theme (right), shown by the number of stakeholders that mentioned the theme. Values within each part of a bar represent the percentage of each stakeholder group that mentioned the theme (e.g., 100% of producers mentioned “collective engagement”).

![Motivations Bar Chart](image)

Themes that motivated stakeholders to record/report land management actions

Fig. 3. Conceptual diagram of the three most mentioned principles that motivate land managers to record and report land management actions that improve water quality.

From a catchment perspective, it is farmers working together on [...] issues and sharing information so that they find out that they’re not working by themselves. But it’s actually making progress collectively so they can share what works and what doesn’t so they don’t have to reinvent the wheel all the time. But they are continually improving what those practices look like. - Gov5

The magnitude of influence that people in a community can have on the behavior of others is well recognized. Collins (2018), for example, found that farmers’ beliefs, emotions, behaviors, and attitudes toward land management actions that improve water quality were not only influenced by conversations between farmers themselves, but also by what farmers heard or observed other farmers saying or doing. Our findings confirmed the importance of collective engagement for environmental progress-making and social learning. Social networks included catchment care groups, organized farmer activities such as field days, and discussions between farmers and public or community groups (e.g., “I was talking to one [a farmer] yesterday.” - Comm2). Social learning through collective engagement can contribute to a change in the understanding of certain issues and can lead to change in community behavior, in our case, an increase in systematic recording and reporting of actions that improve water quality.

You would hope that it would be motivating for people if they saw that there were a lot of other people [recording and reporting] and perhaps if they weren’t, that they then wanted to do the same - F2

By sharing knowledge, communities not only better understand specific water quality issues within their catchment (e.g., the river has too many nutrients), but also better understand what actions can be done to lessen the impact (e.g., we can keep stock out of the river to reduce nutrients). In the context of responsible environmental behavior theory, these principles align with variables 1, knowledge of issues, and 2, knowledge of action strategies (Hines...
Collective engagement through catchment care groups can be a powerful way to induce changes in practice and can provide an important platform for capacity building, information exchange, and innovation in rural settings (Yaffee and Wondolleck 2000, Bouwen and Taillieu 2004, Pahl-Wostl et al. 2007, Blackstock et al. 2010, Tadaki et al. 2020, Albizua et al. 2021).

But if you start creating that collective responsibility, then you can go. ‘Oh yeah, you’ve put a hundred [trees in] – we’ll do a hundred, too.’ – that kind of mentality. - Comm1

Catchment community collaboration that addresses on-farm management issues to improve water quality has surged worldwide over the last 15 years, a testament to the importance of this issue (Ministry of Agriculture and Forestry 2010, Barnett 2014, Sinner and Newton 2018, NZ Landcare Trust 2020). Examples include Streamwatch (https://australian.museum/get-involved/citizen-science/streamwatch/), the Manawatu Catchment Group in New Zealand (Barnett 2014), the Mersey Rivers Trust River Guardians (https://www.merseyrivers.org/index.php/projects/river-guardians), and the Chesapeake Monitoring Cooperative (https://www.chesapeakemonitoringcoop.org/).

Our findings suggest that collaborative engagement can be a powerful motivator for land managers to record and report their land management actions that help improve water quality. However, making change through collective action is highly dependent on a land manager’s identity and the social norms within a community (Mills et al. 2011, Emery and Franks 2012), which is our second motivation principle.

Motivation principle 2: identity and social norms

The norms that govern communities influence behavior (Cacciatore et al. 2016, Longnecker 2016, Priest 2016). Social norms are unwritten rules that reflect society’s shared beliefs and ideas about how people should behave (Eggertsson 2001) and what behavior is or is not acceptable (Hechter and Opp 2001). In our study, 17 of 23 participants alluded to the importance of social norms and how they motivated recording and reporting of land management actions. Looking at the 50 most-used words within the social norms theme, the word “people” was the most frequently cited word (51 times), followed by “look” (35 times; Fig. 4). We explored the connections that were made with those two most frequently used words through word trees and found that both words were commonly linked to the principle of satisfying the norms set by their communities. For example, the word most often used in conjunction with “people”, was “other” (i.e., “One of the big things is how we’re perceived by other people [...]” - Prod5; “Yeah, but it’s also important that other people driving past think that you care” - Prod2; Fig. 5).

Similarly, the meanings behind the word “look” were almost entirely related to the principle of being seen as a responsible community member by others (i.e., “[We’re] quite keen on making the place look nice” - Prod2; “[...] look at me, I am doing something” - Prod4; Fig. 6). This demonstration of a responsible farmer identity by following best practice land management actions was important for land managers themselves, as well as for others. This idea resonates with the theoretical framework’s principle “individual sense of responsibility”, which predicts that land managers who feel some degree of personal responsibility toward the environment will be more likely to engage in pro-environmental behavior than land managers who do not hold such feelings (Hines et al. 1987).

Social norms can influence behavior toward the adoption of environmental management practices (Anton et al. 2004, Horbach 2008, Farrow et al. 2017, Collins 2018). For example, Minato et al. (2010) showed that the visual evidence of trees being planted provided “social proof” that tree planting was “what everyone did” and increased the likelihood that others would change behavior and plant trees. We also found that land management actions that were visible from the road were done first (e.g., hedge planting), before other, less-visible actions were conducted (e.g., septic tank upgrade). Although we did not specifically test whether social norms encourage recording and reporting of actions, we regard our findings as potential evidence of engaging stakeholders in recording and reporting as a course of habit to satisfy the environmentally responsible norms set by their communities. In our study, land managers’ drive to record and report was influenced by what others did on their farms. This idea is commonly referred to as an “over the fence mentality” (Streletskaya et al. 2020, Weersink and Fulton 2020).

And they can see that farmers are [recording and reporting] themselves, and someone is having great success, then the guy across the fence will start doing it. Then you can start making inroads. - Ind5
A desire to comply with social norms is a factor in pro-environmental behavior change (Farrow et al. 2017), and the concept of copying behavior of others in the community is not new. Rust et al. (2021) showed that their research participants tried a new sustainable land use action if they had the willingness to try something new coupled with knowing someone in their community who had already successfully tried it. Similarly, Coggan et al. (2021) listed numerous examples of the effects that social processes can have on the adoption of improved land management actions, including social networks and social learning. Norms can change through observing respected “trendsetters” or those who question existing norms and start behaving differently (Bicchieri and Mercier 2014). In the context of land management practices, BenYishay and Mobarak (2019) found that if respected community members, also often referred to as champions, promoted pro-environmental behavior, the uptake of actions within the community increased. This “magnetic pull” of following actions done by champions is well documented (Milgram et al. 1969, Young 2009) and has been linked to an “information-processing advantage” and “decisional shortcut” when one is choosing how to behave in each situation (Cialdini 1988). Taken together, our results suggest that land managers would be more motivated to record and report under the following conditions.

1. The people they closely liaise with also record and report actions.

   Farmers are a really social and gregarious people actually. They want to huddle together with their own and they’re typically at sports clubs or bars or at field days, and they learn experientially. So they’ll go, ‘What would dad do? What would granddad do? What are the neighbors doing? What can I pick out of that to put in my property?’” - Gov1

2. The entire community and beyond already records and reports.

   But I think probably it is that peer pressure thing. If it’s seen as good farming practice, if [recording and reporting] is seen as the thing to do, then the farmers that don’t [record and report] are the outliers. - Prod3

3. Specific farmer “champions” within the community or catchment record and report land management actions that improve water quality.

   And there’s now a freshwater champion’s group which is set up and we’ve got two representatives on that group. And what they’re doing is they’re sharing knowledge in terms of ‘Hey, we’re in this catchment. This is what we’re doing, this is what we’re seeing’, and they’re sharing that. - Gov3

Sharing knowledge about land management actions will be essential for the subsequent uptake of those actions by others in the community, which is a critical step in achieving pro-environmental behavior.

   [B]y people like [us], and [us] submitting what [we] do, hopefully that encourages others to do what they need to do. - Prod2

Successful land management, however, goes beyond being “socially approved” by others in a community, and also involves high levels of self-regulatory behavior and self-efficacy. Our third motivation principle further explored this idea by looking at whether recording and reporting of actions that improve water quality can be encouraged by providing efficient farm management frameworks.

Motivation principle 3: efficient farm management

To link water quality actions accurately with water quality outcomes, information needs to be recorded in a meaningful way; as more meaningful information is being gathered, the results will be more reliable and applicable. However, collecting meaningful information that is also detailed and of high quality requires specific skills (e.g., capability to run certain programs) and specific equipment (e.g., digital devices or SmartApps). Most of all, it requires time.
After our group spends the morning collecting river quality data, one of the members spends the rest of the day entering the data into spreadsheets and the national database. So, it’s quite time consuming. - Comm3

We found that stakeholders subscribed to a vast range of quality assurance programs that need to be followed, in addition to environmental standards (e.g., health and safety, food safety, people management).

We have to record for regional council. We have to be able to prepare a nutrient budget [...]. We have to record all our baleage made - nutrients in and out - all your land use stuff to prepare a nutrient plan. We have to record everything for the meat company - that’s two. You have to record all your velveting - so that’s three. If you’ve got a safe handler certification for using chemicals - so you do your own spraying - you have to have an inventory of all your drenches. You have to have all your material safety data sheets online, and you have to record all your spraying - so that’s four. - Prod2

So, asking stakeholders to increase the details and frequency of recording and reporting of land management actions will add another task to their already large recording portfolio in a time-short situation.

For farmers on the ground [new recording and reporting requirements] potentially add more bureaucracy to the system - yet another document - another plan. - Comm5

This situation can quickly become overwhelming, resulting in a barrier to record and report.

I’m not a great recorder of day-to-day stuff; no. I did start [recording] and it’s bloody onerous actually. I’m just trying to think what’s going to overcome my apathy of filling something else in. You should see the problems that [name] has to get me to fill this in every year. I usually wait till they’re threatening to take me to court before I fill it in. It’s usually about lambing time, too, isn’t it? - Prod3

A person’s ability to make change empowers further action. Perceived control, or “locus of control” is an integral factor in determining engagement with information and behavior change (Hines et al. 1987, Longnecker 2016). For example, Aytülkasapoğlu and Ecevit (2002) showed that locus of control was a key determinant among participants to engage in responsible environmental behavior to protect a local lake. We considered efficient farm management as a key motivator to record and report, and any form of duplication with recording and reporting land management actions as a key barrier. We found that “apathy toward filling something in” was a barrier to recording and reporting land management actions for participants, especially when the time commitments were large because the process of recording and reporting was not streamlined. When asked how this reluctance could be overcome, 16 of 23 interviewees agreed that any additional recording and reporting requirements will need to be incorporated with existing monitoring and assurance frameworks (“Yeah, and I don’t want to be going to six different apps to do stuff.” - Prod2).

Global examples of integrated farm management systems include Linking Environment And Farming (https://www.leaf.eco) and Red Tractor Assurance (https://www.redtractor.org.uk). These systems allow primary industries to demonstrate the integrity of their farm management practices, including animal health and welfare, food safety and biosecurity, environmental accountability, and other factors.
If we consider the three socio-psychological principles (1 = collective engagement, 2 = identity and social norms, and 3 = efficient farm management), we are one piece closer to completing the complex puzzle of on-farm freshwater restoration. This figure represents an illustrative concept only, showcasing a subset of potential land management actions relevant to on-farm water quality restoration, their indicators, and hypothetical water quality outcomes.

| Land management action Example 1 | Land management action Example 2 |
|---------------------------------|---------------------------------|
| IMPLEMENTING LAND MANAGEMENT ACTIONS |  |
| 1 Some erosion control actions on erosion prone land |  |
| We are good at doing land management actions. | We do know which actions have been done, where and to what extent. |
| SOLVED PUZZLE PIECE |  |
| 2 Of the 150 ha of erosion prone land, 5% has been retired due to high risk of erosion. | We understand the health of our freshwaters, and reasons why they improve or decline. |
| WATER QUALITY OUTCOMES |  |
| 3 Significant increase in turbidity at monitoring site X over the last 10 years due to 5% of the land being controlled for erosion. |  |
| Significant reduction in total nitrogen at monitoring site Y in Lake Z over the last 5 years due to 98% stock exclusion from lake edge and tributaries. |  |

The red meat sector and others are having conversations about how they adapt a quality assurance program to allow for fresh water and other regulations going forward. So, it could be one system that encapsulates all that, rather than a whole heap of different ones for when you get new plans. - Gov5

Land managers also indicated that they would be more inclined to record and report if a particular land management action fulfilled multiple purposes and resulted in multiple benefits to the farm. For example, while the primary aim of stock exclusion for water quality outcomes is often the reduction of sediments that get washed into the river by stock accessing the river, one land manager highlighted the co-benefit of not losing stock falling into a pond, saving him money in the long term.

You can see [...] there’s a gully with a big pond. We drained that pond one year and I found 22 dead lambs in it. I think on average that creek used to take about six or seven lambs a year. If you said six lambs a year for ten years - sixty lambs at $100 - that’s paid for all the work. That’s how I look at it. - Prod2

Moreover, any recording and reporting outcomes should also provide benefits beyond the farm system alone. Some of the benefits mentioned included amenity values (“Well, it’s a nice place to stop and walk. We’ve got pathways through it, and there’s a little picnic area from some logs that were left there, and there’s a little stone table. So there is an amenity there for people walking and people do stop.” - Comm3), biodiversity benefits (“To me, this is another biodiversity part of our farm and with trees and shelter for our stock, but it’s good for birds and insects” - Prod1), health and safety benefits (“Sometimes there was a farm safety aspect to it - we didn’t want people to drive through [the river]” - Prod1), nutrient management benefits (“[W]e were trying to
change stock behavior with where you put trees. If you’ve got a low fertility area and you can get them to camp under trees, you’re shifting your fertility back down to some of those areas.” - Prod2, and general well-being (“[Y]ou should be able to go out in the paddock and turn the bike off, and sit there and enjoy what you’re looking at. I reckon you do.” - Prod2).

Our results suggest that efficient farm management goes beyond recording and reporting land management actions as a box-ticking exercise for funding bodies or agricultural levy-reporting frameworks. Interviewees mentioned they were more likely to record and report their actions if it was made easy for them to do so and if the actions resulted in more than just one positive outcome. Effective land management due to shorter time commitments and concurrent positive outcomes appeared to be an important factor in influencing the drive to record and report, referred to as the “attitude-behavior” relationship principle (Hines et al. 1987). For this principle, positive experiences are shown to positively influence the attitude of individuals, which leads to increased engagement in responsible environmental behaviors (Bohlerengen and Wiium 2022). Efficient land management will avoid additional strain on land managers and create the perception of capacity within the individual to carry out the act of recording and reporting at a certain point in time and to a specific level. However, if new recording and reporting requirements are added to already busy schedules in inefficient ways, we risk losing engaged and caring stakeholders in our communities.

**IMPLICATIONS AND CONCLUSIONS**

Our interviewees recognized recording and sharing knowledge of land management actions as critical steps toward improving freshwater quality, as well as the provision of consistent indicators and suitable tools to facilitate this knowledge exchange. Our results confirm that a lack of consistent land management indicators and suitable platforms, and the large range of existing farm management tools and guidelines (of which many are highly specific to region or type of land use) made it difficult for land managers to collate and summarize their knowledge for succinct environmental reporting. Although the processes of environmental recording and reporting are not new for New Zealand land managers, there is a perceived lack of guidance as to what, where, and how to record and report land management actions in the day-to-day running of their businesses. This situation results in inefficient environmental monitoring.

To successfully quantify land management actions that help improve water quality in the New Zealand context, national collaboration at multiple spatial scales between multiple players is required. Collaboration will ensure that consistent and suitable information is gathered and shared, enabling effective and meaningful freshwater restoration. Land managers are at the heart of this collaboration, and understanding what hinders and motivates them to record and report is essential for successful large-scale environmental management. Collective engagement, identity, and social norms, as well as efficient farm management actions were themes of key motivators for recording and reporting land management actions. Based on our findings, we propose that these socio-psychological aspects be considered during the establishment of any new on-farm environmental monitoring frameworks or policy implementations. Doing so will empower more holistic and effective farm management and bring us one step closer to linking land management actions to water quality outcomes (Fig. 7).

To conclude, we suggest that five key points need to be considered for systematic environmental recording and reporting to be successful at large scales. While these points are specifically relevant in the New Zealand context, they may be applied in other parts of the world facing similar recording and reporting challenges.

1. Development of standardized indicators of land management actions to allow robust assessment of change over time;
2. Development of easy-to-understand environmental recording and reporting platforms (e.g., National Register of Actions);
3. Integrating new recording and reporting requirements within existing frameworks;
4. Holistic farm management, including stakeholders' on-farm values (i.e., biodiversity, amenity), to encourage ongoing environmental recording and reporting, and;
5. The value of getting catchment champions involved for motivating others within the community to record and report land management actions.

Successfully improving freshwater quality is a complex process that requires actions from different players, at different times, and in different places, while following specific guidelines. It is like solving a puzzle, just not on your own.

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[1] Fonterra (https://www.fonterra.com) is a New Zealand multinational, publicly-traded, dairy co-operative owned by approximately 10,500 New Zealand farmers. The company is responsible for approximately 30% of the world's dairy exports and is New Zealand's largest company in terms of revenue.

[2] Synlait Milk (https://www.synlait.com) is a dairy processing company in New Zealand that manufactures ingredient and nutritional milk powders.

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**Data Availability:**

The data that support our findings are available on request from the corresponding author, K.D. None of the data are publicly available because of confidentiality and privacy restrictions as part of the ethics approval. Ethical approval for this research study was granted by University of Otago D2003.

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APPENDIX 1. Interview schedules for participants.
Survey instrument/Interview schedule for Industry Sector Body & Government

A|Personal Background

1. What is your role at the company you work for? What is your main responsibility in this role?
2. Do you manage any land as part of your role? If yes, can you tell me about the land/organisations you manage?

B|Land management actions

1. Does your company have any processes in place to help improve the environmental impacts on water quality? If yes, can you name a few? 2. What do you think are the benefits associated with land management actions to improve water quality? 3. What are the challenges/pressures associated with management actions? Why are they opportunities/challenges?
4. Does your work have any plans in place to mitigate these challenges? What information would help you to do something about these challenges?

C|Recording and quantification of SLUA

1. Do you record land management actions? If no - go to Q9 If Yes 2. What kind of management actions to improve WQ do you record? 3. How do you record your actions? To what detail? 4. Can you describe the monitoring systems you have in place that tell you about what management actions you currently do? 5. Does your work keep track of any management actions that help improve WQ? 6. Do you do regular ‘stocktakes’? If so, how often? 7. With the data you record, are you able to measure/quantify the actions that help improve WQ? 8. If yes, can you tell me about how you measure your actions? 9. What indicators/measures do you collect?

D|Information gathering and reporting of management actions

1. Thinking about how you keep yourself up to date about management actions to improve WQ - where do you and your company go to seek information? To what extent do you think that data on management actions should be shared? 3. What are the advantages that you foresee with sharing management data? Why? 4. What are the challenges/risks that you foresee with sharing management data? Prompt: confidentiality, privacy.
5. Do you have any plans in place to mitigate these challenges? What incentivises land managers to share data in general? 6. Would you be willing to share your company’s data on management actions and make it publicly available? 7. How would you like to see your data shared? At what level would you be willing to share your data? Prompt: Neighbours, catchment, catchment group.
8. How would you like to see your data protected? Where would you like to see land management action data be stored and shared?

E|National Register of land management actions to improve WQ

1. If there was a national register of land management actions, what would you use it for? 2. Which questions would you try to answer with such a register? 3. Is there something that you would like to see/not see included on such a register? 4. What features would we have to include to make it easy for you to use? 5. What do you think would encourage land managers to share their action data on such a register?

F|Other

1. Is there anything else you would like to mention today that could help make this register useful? Do you have any other comments that you would like to make?

Survey instrument/Interview schedules for producers, community and tângata whenua

A|Personal Background

1. Can you tell me about the land that you manage/own/work on?

B|Land management actions

1. Did you bring any pictures of your land where you applied management actions to improve WQ? Do you want to tell me about the pictures you brought with you today? Why did you choose these pictures? 2. What do you understand under sustainable land management? 3. Do you think your actions are sustainable? 4. Tell me about land management actions on your land which help improve water quality? What do you think are the challenges associated with management actions that help improve water quality? Why are they challenges?

C|Recording and quantification of SLUA

1. Do you record land management actions? If no - go to Q9 If Yes 2. What kind of management actions to improve WQ do you record? 3. How do you record your actions? To what detail? 4. Do you use an app to manage your land? 5. Can you describe the monitoring systems you have in place that tell you about what management actions you currently do? 6. Do you keep track of your management actions to improve water quality? 7. Do you do regular ‘stocktakes’? If so, how often? 8. With the data you record, are you able to measure/quantify the actions that help improve WQ? 9. If yes, can you tell me about how you measure your actions?
10. What indicators/measures do you collect?
1. Thinking about how you keep yourself up to date about management actions, where do you go to seek information? (Internet groups, field days, neighbours, forums etc)  
2. So overall, how much of the data collected about management actions by landowners should be shared by everyone?  
3. What are the challenges/risks that you foresee with sharing management action data? Are there particular ones that you associate with sharing your data?  
4. Do you have any plans in place to mitigate these challenges?  
5. What are the advantages that you foresee with sharing management data? Why?  
6. Would you be willing to share your management data and make it publicly available?  
7. How would you like to see your data shared?  
8. Where would you like to see/be comfortable with your data to be stored and shared?  
9. At what level would you be willing to share your data?  
10. How would you like to see your data protected?  
11. If there was a national register of management actions, what would you use a register like this for/to what extent would this be useful to you?  
12. Which questions would such a register help you to answer?  
13. Is there something that you would like to see/not see included on such a register?  
14. What actions/indicators should we be recording on the register?  
15. How should it be set up to make it easy for you to use?  
16. What do you think would encourage other land managers to share their action data on such a register?  
17. What would you get out of others sharing their data? Could this information help you with overcoming some of the challenges we talked about earlier?  
18. Would you yourself add management action data onto a platform?  
19. Is there anything else you would like to mention today that could help me make this register useful? Do you have any other comments that you would like to make?