



Managing and protecting native biodiversity on-farm – what do sheep and beef farmers think?

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Abstract: Despite one-third of New Zealand's landmass being protected as public conservation land, the country still faces significant conservation challenges. Nearly 50% of the country's landmass has been converted to pastoral farming, and biological invasions pose a sustained and growing threat to remaining biodiversity across all land tenures. Managing and protecting biodiversity on-farm provides vast opportunities to create nature-rich pastoral landscapes. A key step towards bringing about necessary behaviour change to achieve this is increasing insights into farmers' attitudes towards the value of native biodiversity on their farms. Using a questionnaire underpinned by the Theory of Planned Behaviour, we surveyed 500 sheep and beef farmers from around New Zealand as to their beliefs and attitudes and perceived barriers relating to the protection and management of native biodiversity on their farm. Although the survey respondents were largely homogenous, the surveyed group of farmers were heterogeneous in their responses. When asked about advantages associated with managing and protecting native biodiversity on their farms, 690 distinct responses were provided, spanning social (47%), environmental (34%), practical (10%), and economic (2%) themes. In contrast, identified disadvantages were fewer (530 distinct responses) and less wide-ranging in scope, clustering around economic (44%), practical (26%) and social (25%) themes. Nearly three times as many farmers stated there were no disadvantages (22%) than stated there were no advantages (8%). However, the most frequently cited disadvantages were cost and time, which were also commonly cited as barriers to managing biodiversity. Our study illustrates that sheep and beef farmers perceive many advantages in maintaining native biodiversity on-farm, but there is a clear desire for greater support in overcoming identified barriers and this will require a targeted policy response.

Keywords: agroecosystems, behaviour change, biodiversity policy, pastoral farming

Introduction

Native biodiversity is important not just from intrinsic conservation and cultural perspectives, but also for the long-term sustainability and resilience of farm systems and for sustaining the provision of the full range of ecosystem services (Norton & Reid 2013; Dominati et al. 2019; Maseyk et al. 2019). The continued decline of our natural capital, including native biodiversity (Brown et al. 2015; Boston 2018; Ministry for the Environment & Stats NZ 2018) poses a fundamental challenge for New Zealand. While the detrimental impacts of invasive species are ubiquitous across the landscape irrespective of land tenure, many management practices associated with farming are also key drivers of ecosystem decline in agroecosystems. For example, vegetation clearance, wetland drainage, application of fertiliser, herbicide or pesticides, discharge of effluent to sensitive receiving environments and

grazing of forest remnants (Parliamentary Commissioner for the Environment 2015; Ministry for the Environment & Stats NZ 2018; Monks et al. 2019). Thus, pastoral farming has had a major impact on New Zealand's biodiversity and ecosystem function. Conversely, land in pastoral use holds vast potential to create nature-rich landscapes. Nearly forty percent (39.7%, c. 10.6 million ha) of New Zealand's total land area is used for sheep and beef farming, and supports one-quarter (24.5%, 2.8 million ha) of the total remaining woody native vegetation (Norton & Pannell 2018). Sheep and beef farming thus supports the greatest proportion of remaining woody native vegetation outside of public conservation land. The way in which private land generally (Hanley et al. 2012), and sheep and beef land use specifically, is managed has major implications for biodiversity conservation nationally, and farmers, as land managers, have a critical role to play (Thompson et al. 2015).

However, at the national scale, regulatory policy methods for the explicit purposes of biodiversity management are not uniform, and where they do occur, are often not coupled with the compliance monitoring and enforcement necessary to achieve policy objectives and are thus in effect, currently relatively scant (Brown et al. 2013; Brown et al. 2016). Further, additional policy responses and nudges such as economic mechanisms to incentivise specific behaviours are currently infrequently used, and not at all in many jurisdictions (Brown et al. 2016). Therefore, we are heavily reliant on farmers exhibiting pro-biodiversity practices on-farm on a largely voluntary basis; for example, actively planting, removing grazing to allow for passive regeneration, or placing areas under legal protection. By 2018 about 100 000 ha (3% of remaining indigenous vegetation cover occurring on sheep and beef farms) had been legally protected under a Queen Elizabeth II National Trust Open Space Covenant (Norton & Pannell 2018). Despite both government and voluntary conservation activities across New Zealand, biodiversity continues to decline, including that on private land (Ministry for the Environment & Stats NZ 2018; Monks et al. 2019).

For agroecosystems, a shift in behaviour towards more pro-biodiversity management practices on-farm is required for transformative change at catchment and regional scales. Conservation problems are closely entwined with human behavioural problems (Reddy et al. 2017). As such, there is merit in better understanding the perspectives and values of those whose behaviour we may wish to change or support. However, there remains a gap in our understanding of what is required to create and support changes in how native biodiversity is understood, valued, protected, and managed on-farm.

Farmer motivations and perceptions of performing pro-biodiversity (or environmental) behaviours are complex and dynamic (Reddy et al. 2017) and cannot be definitively explained (Kollmuss & Agyeman 2002). Multiple drivers may influence motivations and uptake of specific behaviours to various degrees including conservation, lifestyle, social, political, and economic factors, and whether the behaviour is deemed by individuals as 'fit for purpose'. These factors are themselves dependent on the specific pro-biodiversity action in question, farm context, marginal gain achieved, previous behaviours or involvement in schemes, paradigmatic perspectives, and farmer and household characteristics (Wilson & Hart 2000; Pannell et al. 2006; Davies & Hodge 2007; Greiner & Gregg 2011; Karali et al. 2014). Motivations and behaviours are in turn influenced by personal values and perspectives (Davies & Hodge 2007), and social norms (Ajzen 1991; St John et al. 2010; Kuhfuss et al. 2016; Lute et al. 2018).

Our study was interested in New Zealand sheep and beef farmers' perceived consequences from managing and protecting native biodiversity (expressed as advantages and disadvantages), and behavioural controls on doing so. These elements are theorised to influence behavioural intentions as conceptualised by the Theory of Planned Behaviour (TPB; Ajzen & Fishbein 1977; Ajzen 1991), an adaptation of the earlier Theory of Rational Action (Fishbein & Jaccard 1973; Ajzen & Fishbein 1977). The TPB conceptualises a person's intentions to do something as the most proximal influence on their subsequent behaviour and recognises that an individual's intentions are influenced by their attitudes towards the behaviour, subjective norms, and perceived behavioural control; which are in turn influenced by an individual's evaluative beliefs about the outcomes (Ajzen 1991). Evaluative beliefs capture an individual's evaluation of the anticipated outcome resulting

from them partaking in the behaviour: whether the desired outcomes will be achieved, or whether impacts will be negative or positive from the individual's perspective. The assumption of behavioural control is a critical factor of particular relevance to our study, in that negative perceived control factors (barriers; e.g. cost and effort) may prevent action even when the intention exists, while positive perceived control factors (facilitators; e.g. policy or financial incentives) may nudge behavioural intention towards behavioural action.

The TPB has become the dominant social psychology model for explaining volitional human behaviour (Fishbein 2015). However, the TPB is not without its criticisms, and there has long been debate surrounding the influence of attitudes on intention and behaviour (LaPiere 1934; Allport 1935; Eagly & Chaiken 1993; Johnson & Boynton 2010). Additionally, some researchers have shown that causality may also work the other way, with attitudes being influenced by behaviour (Festinger & Carlsmith 1959). Meta-analyses of TPB studies have shown a wide range of correlations or explained variance when evaluating the influence of attitudes on behaviour (Wicker 1969; Ajzen 1988; Sheppard et al. 1988; Kraus 1995; Albarracín et al. 2001; Albarracín et al. 2004) and it is likely that attitude and behaviour are bi-causal phenomena. However, as previous studies have demonstrated the validity of the TPB in explaining an individual's pro-environmental behaviour (Kilbourne & Pickett 2008; Sidique et al. 2010) we relied on the fundamental assumptions of the TPB when structuring our nation-wide phone survey.

The results of the phone survey illuminate sheep and beef farmers' perceptions of managing and protecting native biodiversity on-farm and provide quantitative data to allow for theoretical modelling. Here, we present the observations of the advantages and disadvantages and perceived barriers of managing and protecting native biodiversity on-farm, and highlight some of the ongoing challenges in reversing the decline of New Zealand's native biodiversity. These observations will be useful to inform future policy initiatives and support packages to increase pro-biodiversity behaviour on-farm.

Methods

Data collection

A survey of 500 sheep and beef farmers was conducted by phone between March and April 2019 (in accordance with AUT Ethics approval). The survey was constructed to reflect the theoretical assumptions of the TPB and comprised a total of 12 questions with additional questions relating to the characteristics of the farm and demographics of the respondents (see <https://doi.org/10.34721/sg0q-2x29> for survey transcript). Including preamble and postscript, the survey took approximately 15 minutes to complete. In this paper, we focus on data from four of the 12 questions. These four questions were open-ended to allow for unrestricted responses.

The phone survey was conducted by UMR Research, a market research company specialising in public opinion. Survey participants were sourced from Beef+Lamb New Zealand's database. Beef+Lamb New Zealand is a farmer-owned organisation, funded by commodity levies on all sheep and cattle processed in New Zealand. The survey sample was stratified across the seven Beef+Lamb operational regions and 630 people initially agreed to participate. The 500 farmers screened into the survey included only those who self-identified that they had native biodiversity on their farm.

Data analysis

Qualitative content analysis methods (adapted from Erlingsson & Brysiewicz 2017) were used to identify patterns and similarities in the responses to the open-ended survey questions. This involved three key steps that are presented here as a step-wise process, but which were applied iteratively.

(1) Verbatim raw data were read to give a general sense of the response.

(2) The main ideas expressed were identified and grouped into categories describing the manifest (what is obvious) content, using an inductive process (informed by the responses themselves).

(3) Similar categories were grouped into four themes (environmental, economic, social, and practical) which expressed the data in a more latent (interpretative) way.

To reduce bias in the categorisation of responses, each question was analysed and then reviewed by a different researcher. This process was iterative and categorisation was adjusted where inconsistencies were identified.

The boundaries between categories are not absolute and the categorisation of responses was informed by the essence of the response as a whole. Likewise, the themes are not independent of each other and some environmental or social considerations may ultimately also influence the management of the farm and so influence economic values and considerations, e.g. erosion control or labour. However, the categorisation is a useful way to provide a broad overview and interpretation of the views of the survey participants. Dissimilar responses that could not be grouped with other categories and themes were categorised as other.

Results

Farmer demographics

The vast majority of survey respondents were male (90%; $n = 449$), most of whom were 45 or older (88%; $n = 397$). This age distribution was similar for the small group of female survey respondents, with 90% ($n = 46$) falling into the 45 or older age ranges (Fig. 1). There was little ethnic diversity, with 95% ($n = 474$) of survey respondents identifying as New Zealand European or Pākehā; 3% ($n = 15$) as Māori; and 2% ($n = 11$) as other.

Across all survey respondents, secondary schooling was the highest level of education for nearly half (49%; $n = 243$), followed by tertiary education (43%; $n = 217$) (Fig. 1). Three-quarters of the survey respondents identified as owner/operators (76%; $n = 379$), with the remainder comprising owners, managers, and lease holders; and four (0.8%) respondents identified as directors or trustees – hereafter we collectively refer to all the survey respondents as farmers.

Farmer perspectives on the advantages of managing and protecting native biodiversity on-farm

A total of 690 responses described advantages of managing and protecting native biodiversity on-farm (across the social, environmental, farm management, and economic themes), with only 8% ($n = 39$) of farmers stating there were no advantages at all (Table 1). Social advantages were the most prominent (47%; $n = 327$) and included benefits to the farmer, their family and staff, as well as off-farm advantages such as intergenerational equity and meeting the responsibility of land management. Environmental advantages were also common (34%; $n = 238$) and included concepts of benefits for biodiversity in and of itself, and contribution to other environmental considerations. Practical advantages, such as pro-diversity actions making farm management easier, were identified much less frequently (10%;

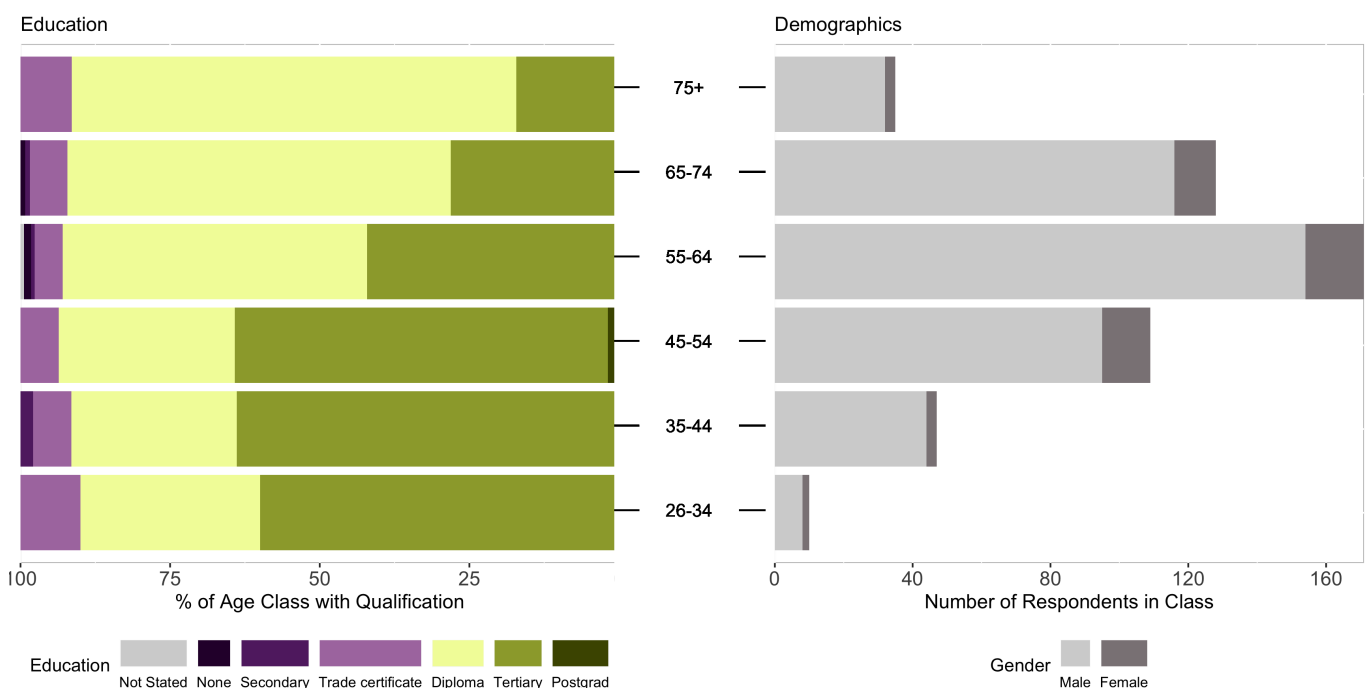


Figure 1: Proportion of survey respondents by age class, level of education (left) and gender (right). Legend categories are presented in order they are plotted.

Table 1. A summary of categories (excluding other) reflecting advantages and disadvantages of managing or protecting native biodiversity on-farm as identified by survey participants. Categories are grouped by theme: environmental, economic, social, or practical theme. Percentage of total responses within each category given in brackets.

Theme	Advantages <i>n</i> = 690	Disadvantages <i>n</i> = 530
Environmental	<i>n</i> = 238 (34) Native flora and fauna protection (11) Water quality (7) Managing the environment (6) Erosion control (3) Restoration (3) Habitat provision (3) Sustainability (1)	<i>n</i> = 0
Economic	<i>n</i> = 14 (2) Farm value (2) Alternative income streams (0.4)	<i>n</i> = 235 (44) Cost (40) Lack of financial return (3) Distraction from the business (2)
Social	<i>n</i> = 327 (47) Intergenerational equity (11) Feel good factor (10) Aesthetics (10) Quality of life (4) Meeting of responsibility (4) Benefits for wider community (3) Reputation (2) Autonomy (2) Policy and regulation (1)	<i>n</i> = 130 (25) Time (13) Labour / workload (5) Policy and regulation (3) Community attitude (2) Knowledge (1)
Practical (on-farm management)	<i>n</i> = 70 (10) Animal wellbeing (4) Fencing and planting (4) Land use change (2)	<i>n</i> = 140 (26) Loss of land and production (12) Weeds and pests (8) Access (3) Fencing and planting (3) Land use change (1)

n = 70). Economic advantages were infrequently mentioned (2%; *n* = 14), but responses were dominated by ideas relating to increased farm value due to biodiversity on-farm. A further 6% (*n* = 41) of responses were grouped together as other. These responses were infrequent enough to not warrant a separate category and were wide-ranging in content (e.g. “part of the life cycle”, “balances the farm system”), or were generic and thus eluding obvious categorisation (e.g. “it’s a good thing”).

Social advantages were experienced on and off-farm, with intergenerational equity being the most common (11%; *n* = 76). This category included the idea that managing native biodiversity on-farm was “enhancing it for future generations”. The survey participants also commonly indicated that pro-biodiversity actions enhanced the experience of living and working on the farm. This enhanced experience was sometimes expressed in terms of a “feel good factor” (10%; *n* = 72), with farmers describing the feelings these actions and the presence of native biodiversity on their farm gave them. One farmer put it this way: “The main thing is you feel proud of what you are doing keeping things natural as possible”. Other farmers (10%, *n* = 68) described the aesthetic benefits of native biodiversity – “it is going to look prettier”. Both of these ideas related to the concept of improved quality of farm life for families and staff, due to native biodiversity, expressed more explicitly by several farmers (4%, *n* = 31), as in this quote: “It will enhance and make it [the farm] a better place to live”. Additional advantages were categorised as meeting responsibility (4%; *n* = 28) including responses relating to duty, obligation, moral

responsibility, and guardianship. One farmer expressed it simply as “it is the right thing to do”. Another farmer stated “protecting things for the future, we have a moral obligation. New Zealand’s natural resource it’s who we are and what we are”. Taking pro-biodiversity actions on farm were also seen as having benefits for the wider community (3%; *n* = 21) including at the national scale (e.g. “good for our whole country”). A few farmers identified maintaining reputation as an advantage (2%; *n* = 13) for both marketing and general reputation, with one farmer highlighting how this “helps with selling product overseas” and another stating “if we change the perception of farming it has got to be a good thing”.

Stated environmental advantages for managing and protecting biodiversity on-farm included concepts of benefits for biodiversity in and of itself, and contribution to other environmental considerations that produced benefits for the farm system (e.g. erosion control) and beyond the farm (water quality) (Table 1). The most frequently mentioned advantages of pro-biodiversity actions were native flora and fauna protection (11%; *n* = 76), including concepts of helping species survive (e.g. “gives animals and plants a fair go”). Protecting biodiversity on-farm to improve water quality was considered an advantage by some farmers (7%; *n* = 51); while a few (3%; *n* = 23) responses related to erosion control (e.g. “less slipping”). The restoration of vegetation was seen as an advantage by a few farmers (3%; *n* = 21), who considered such actions “reverse the decline” and provides habitat for other species (e.g. “brings plants and animals back”). A further 6%

($n = 40$) of responses related to managing the environment in a more general sense.

The benefits for managing the farm system due to the practical actions taken to manage and protect native biodiversity on-farm were also recognised. Most common of these were the improvements in farm management due to fencing (4%; $n = 30$) to exclude stock from bush blocks, gullies, wetlands and waterways, such as providing “better stock control” and “better pasture”. Fencing was also considered to improve animal well-being (4%; $n = 28$), noting, for example, that a fence “keeps animals out of danger”. A few farmers (2%; $n = 12$) highlighted that native biodiversity on-farm represented the best fit of land use in the less productive and marginal areas of the farm stating “some parts of the farm are better off native”; and “it is not economic to try and keep some areas as grazing”.

Economic advantages were raised infrequently (2%, $n = 14$) but included concepts of increasing the farm value (2%; $n = 11$), for example, “adds to our asset value in the long term”, and the provision of alternative income streams (0.4%; $n = 3$) as it “encourages tourism”.

Farmer perspectives on the disadvantages of managing and protecting native biodiversity on-farm

In contrast to stated advantages, there were fewer, and less diverse responses relating to disadvantages ($n = 530$). No environmental considerations were identified as disadvantages (Table 1). Nearly three times as many farmers stated there were no disadvantages at all (22%; $n = 114$) than stated there were no advantages. Economic considerations were most often mentioned (44%; $n = 235$); practical (26%; $n = 140$) and social considerations (25%; $n = 130$) were identified as disadvantages in almost equal proportion covering a greater range of ideas compared with economic considerations. The remaining 5% ($n = 25$) of responses were categorised as other.

In terms of economic considerations, the cost of protecting biodiversity was by far the primary concern (40%, $n = 211$). In addition, 16 farmers (2%) were also concerned with the lack of financial return, expressed by one farmer as “paying rates for land we do not even get an income from”. Protecting biodiversity was seen as a distraction from the core business of farming by a few (1%, $n = 8$), with one farmer noting “it would interrupt our farm business”.

Social disadvantages were heavily weighted towards the investment of time (13%, $n = 68$), and this social investment was closely related to the cited financial cost of managing and protecting biodiversity on-farm. A related social disadvantage was the fact it “creates a lot of extra work”, although comments describing labour needs were less common (5%; $n = 27$). Eighteen (3%) of the comments describing disadvantages related to policy and regulation, as characterised by this comment from one farmer “the controls that are put onto to us from the council that limits us”, and another suggesting such requirements are “infringing on property rights”. One farmer felt such controls were uninformed and they were “getting told what to do from people who don’t even know what they are talking about”.

From a practical perspective, some farmers expressed concern that protecting biodiversity would mean a loss of land or production (12%; $n = 64$). As one farmer commented, protecting biodiversity “limits areas to produce livestock on”. A much less commonly (3%; $n = 18$) expressed but related disadvantage was the impact on movement around the farm and access to resources. One farmer suggested native biodiversity causes “physical restrictions on livestock movements” while

another noted that it “is an issue as it stops us and animals fully getting access to the water”. The cost of maintaining fencing was considered a disadvantage by 15 farmers (3%). Concern over the implications for pest animal and weed control due to fencing these areas was also raised by some farmers (8%; $n = 40$).

Barriers to managing and protecting native biodiversity on-farm

Nearly one-third of farmers surveyed (31%; $n = 157$) felt that there were no barriers to managing and protecting native biodiversity on-farm. From the remaining farmers, the survey yielded 481 responses relating to barriers, spanning economic (44%; $n = 214$), social (37%; $n = 176$), environmental (9%, $n = 44$), and practical (7%; $n = 36$) considerations (Table 2). A further 2% ($n = 11$) of responses were categorised as other.

Of the economic barriers identified, the vast majority (95%; $n = 204$) were categorised as financial implications (e.g. “cost”). A lack of resources was also identified as a barrier, but only by a few farmers (2%, $n = 10$), and one farmer noted “it is just a matter of putting resources into it”.

Social considerations were wider ranging than economic barriers. Half (50%; $n = 88$) of the identified social barriers related to the time required to manage and protect biodiversity on-farm. Policy and regulatory requirements were viewed as a barrier by some farmers (7%; $n = 36$). Frustration was expressed that, as one farmer put it “rules and red tape get in the way from managing it myself”. The lack of labour was also perceived to be a barrier by some (7%; $n = 34$), which, while categorised here as a social consideration, also has financial implications. A few farmers (2%; $n = 11$) felt that attitudes of the wider community created barriers (e.g. “stigma of being a farmer”, “people’s romantic ideas about biodiversity”) and there was frustration expressed towards “do-gooders” and “townies” amongst these responses. Few farmers (1%; $n = 7$) saw their lack of knowledge as a barrier, whether that was “a lack of knowledge of pests”, or in terms of “understanding how much that is impacting”.

Environmental factors were much less frequently identified as barriers, but of those raised the majority (93%, $n = 41$) related to the environment and climate, with farmers noting “steep and rocky” terrain and “flooding that washes away fences” as barriers. Practical considerations were much less commonly mentioned, but included challenges with fencing (3%, $n = 16$) and managing weeds and pests (2%, $n = 11$).

Farmers views on overcoming barriers to managing and protecting native biodiversity on-farm

Fifty-two farmers (10%) were not sure what actions would make the job of managing and protecting biodiversity easier for them and 77 farmers (15%) said “nothing” would. A total of 457 ideas of how to overcome barriers were expressed. Economic (44%; $n = 200$) and social considerations (44%; $n = 199$) were most frequently mentioned. Practical considerations were much less frequently mentioned, accounting for only 8% ($n = 36$) of responses. Thirteen responses (3%) were dissimilar enough to be categorised as other (Table 2).

Increased resourcing was frequently mentioned (42%; $n = 191$) as a key mechanism to make the managing and protecting of biodiversity on-farm easier. This resourcing included direct covering of costs to undertake actions, such as funding, subsidies, or grants or covering the costs in full whether by “somebody paying me to do it” or “if the government would pay for it”. In addition to increasing financial resourcing,

Table 2. A summary of categories (excluding other) reflecting the things that would make managing or protecting native biodiversity on-farm harder (barriers) or easier (enablers). Categories are grouped by theme: environmental, economic, social, or practical. Percentage of total responses within each category given in brackets.

Theme	Barriers to implementing pro-biodiversity management actions <i>n</i> = 481	Enablers for implementing pro-biodiversity management actions <i>n</i> = 457
Environmental	<i>n</i> = 44 (9) Physical environment and climate (9) Managing the environment (1)	<i>n</i> = 0
Economic	<i>n</i> = 214 (45) Cost (42) Resourcing (2)	<i>n</i> = 200 (44) Resourcing (42) Profitability (2)
Social	<i>n</i> = 176 (37) Time (18) Policy and regulation (7) Labour / workload (7) Community attitude (2) Knowledge (1)	<i>n</i> = 199 (44) Assistance (14) Knowledge (8) Policy and regulation (5) Community attitude (4) Labour / workload (4) Time (3) Social and professional networks (3) Autonomy (2)
Practical (on-farm management)	<i>n</i> = 36 (7) Fencing and planting (3) Weeds and pests (2) Access (1) Loss of land and production (1)	<i>n</i> = 45 (10) Weeds and pests (8) Fencing and planting (2)

the need for additional practical assistance was frequently mentioned (14%; *n* = 63). This most often applied to fencing or planting but also a general desire for “more help with things” was mentioned. In a similar vein, overcoming labour issues was a relatively common response (4%; *n* = 20).

Assistance with weed and pest control (e.g. “if we could get assistance to control the pests”, “access to traps”) was also raised (8%; *n* = 38), and this included others (typically councils) doing a better job. As one farmer suggested, “somebody could control the rabbits”. The need for more knowledge was noted by some (8%; *n* = 36) including the provision of advice and information whether as “more easily accessible information” or “better education, seminars or field days”. On a similar theme, increasing networks such as via “more local small group get together” was suggested as a method to remove barriers, but infrequently (3%; *n* = 12).

Overcoming a negative community attitude towards farmers and the farming industry was raised a few times (4%; *n* = 20), reflecting an element of frustration with the non-farming community. This was expressed as, for example, “a reduction in the negative attitude of greenies, Fish and Game etc.”, or a wish that effort put into criticism of farming could instead be directed into positive actions. For example, “all the moaning townies can come out on a Saturday and help me plant trees”. Some farmers also expressed a desire to be better appreciated, as one farmer put it, “[I] would like recognition from urban people”. The concepts of being recognised, encouraged, and giving farmers a break ran together – as one farmer summarised, “if they acknowledge what we do inside the farm gate – give us a pat on the back for what we are doing, instead of giving us a slam”.

Retaining autonomy was infrequently raised (2%; *n* = 10) but centred around being left to get on with it without external interference, for example, “I am happy to do it. I don’t want

someone from regional council coming along and telling me what to do”. The role of policy or regulation was raised by a small number of farmers (5%; *n* = 23), specifically regarding the need for economic incentives such as “tax advantages and carbon credits” but only four of the responses in this category specifically suggested less regulation.

Discussion

The farming community, like any sector of society, does not hold a unified position. This paper does, however, bring together insights into how New Zealand’s sheep and beef farmers perceive native biodiversity on their farms. Further, we identify key behavioural control factors likely to be barriers to undertaking pro-biodiversity behaviour on-farm.

Farmers identified numerous, principally social and environmental, advantages in managing and protecting native biodiversity on-farm. Critically, these advantages were realised both on- and off-farm, indicating that farming families, the farming community, and the wider public benefit from the protection and management of biodiversity on-farm. However, we focus our discussion on the barriers raised during our study principally because overcoming barriers will be critical to bring about necessary behaviour change. This is not to say that the multiple advantages that the participant farmers identified should be overlooked, or the value of biodiversity to the farm beyond a ‘nice to have’ understated. Recognition of these benefits and values associated with biodiversity on-farm provides validation for continuing to pursue public policies aimed at improved biodiversity protection and management, and can help shape packages to support those policies.

Provision of additional support

The extent and condition of biodiversity in any landscape is not static, nor does it change in only one direction. Thus, human activities can enhance as well as degrade biodiversity, providing opportunities for enhancing biodiversity assets on-farm (Timmins et al. 1987; Benayas et al. 2009; Benayas & Bullock 2012; Norton et al. 2016). However, farmers have multiple goals for their farms, and their beliefs and perceptions about what is ‘good management’ (or a good outcome) is not straightforward or uniform (Gosling & Williams 2010). Our study suggests that further effort is required to ensure farmers feel more supported, and therefore more able, to undertake biodiversity management on their farm. The need for advice and support to accompany initiatives (e.g. agri-environmental schemes) to encourage pro-biodiversity behaviour is common (e.g. Wezel et al. 2018).

Many councils and other agencies already provide assistance in various forms to landowners, but our study indicates that increasing and broadening scope and delivery of such support would be beneficial. Our study also suggests that the uptake and effectiveness of programmes will be influenced by farmer perceptions regarding these agencies generally, and their role and expertise in biodiversity management and protection on-farm specifically. This may indicate a requirement for more or different information and support, or alternatively, through different channels, such as via those independent of government such as biodiversity ambassadors (experts who connect biodiversity management advice and resources to farmers) (Norton & Reid 2013; Norton et al. 2020). However, any provider of advice will need to understand farm systems as well as ecological restoration to overcome concerns of uniformed interference that was expressed by a small minority of farmers in our study. In light of the TPB, this is of particular importance as not trusting an information source will act both directly as a control factor and indirectly via the individual’s attitude to the behaviour and evaluative beliefs about the outcome of the behaviour.

The role of public policy in influencing behavioural intentions

A comprehensive policy framework can enable the coordinated or systematised assistance that our survey participants identified as important to overcome barriers to managing and protecting biodiversity on-farm, e.g. providing publicly-funded assistance, education and outreach programmes, or reducing financial barriers. In addition, public policy has an important role to play in defining socially acceptable behaviours and thus influencing social norms (Lynne et al. 1995), which heavily influence farmer behaviour (Kuhfuss et al. 2016). However, the policy challenge facing improving biodiversity stewardship on private land is as complex as it is urgent, and the full potential of a multi-pronged and agile policy response has thus far been under-used in New Zealand (Brown et al. 2016; Boston 2018). Recognition of this complexity is important when contemplating our survey results. A myriad of policy responses will be required to influence a shift in attitudes, beliefs, and individual intentions, and as a consequence effect behaviour change. Although complex, the role of public policy is important for both driving (shifting social norms) and enabling (removing perceived controls) behaviour change.

Overcoming financial barriers

Our study shows that the financial and time investment required

is a major barrier to undertaking pro-biodiversity actions on farm, which suggests that farmers are weighing financial considerations against environmental and conservation considerations. This resourcing challenge is evident in other studies (Lute et al. 2018), and there would seem an obvious public policy case to enable the financial incentivisation of pro-biodiversity behaviours to manage existing biodiversity assets and enhance depleted assets in the first instance as an integral part of all these initiatives (Stephens et al. 2016; Doole & Maseyk 2020; Norton et al. 2020). Incentivising the maintenance and enhancement of existing biodiversity values is especially relevant given the costs of addressing environmental degradation and depletion of natural capital is escalating for both the private and public purse. Examples of this increased expenditure include the \$8.8 million Hill Country Erosion fund (Ministry for Primary Industries 2019), and the \$100 million invested in the Freshwater Improvement Fund (Ministry for the Environment 2019).

However, the effectiveness of incentives to change individual behaviours depends in part on the strength of incentive that an individual needs to change and the relative advantage they can see in adopting the behaviour (Pannell 2004; Pannell et al. 2006). Increasing the understanding of the value of biodiversity to the farm system and maintaining profitability (Dominati et al. 2019) will help shift perceptions towards biodiversity from a ‘nice to have’ to an investment that makes good business sense. Resourcing invested by councils and industry groups to build on this momentum will make a valuable contribution to improving biodiversity stewardship on-farm.

Voluntary programmes and partnerships tend to resonate most successfully with early adopters and those individuals who are open to change and new practices and can facilitate positive outcomes (Dessart et al. 2019). In addition, economic levers (Stephens et al. 2016; Boston 2018; Tax Working Group 2019) can help to both incentivise behaviour change and provide additional support to individuals in recognition of the public good outcomes of enhancing biodiversity on-farm. Economic policy instruments are appropriate in cases where there have been market failures, as is relevant to biodiversity management (Pannell 2004), and to provide support to protectionist policies which may increase costs of production (Stephens et al. 2016). However, such incentives must occur in parallel with the necessary levels of regulatory protection as fitting for scarce natural resources, and not simply replace those policies. Further, as decisions to adopt more sustainable practices are not entirely rational from a neoclassical economic perspective (Dessart et al. 2019), economic incentives will need to be combined with other policy responses that both set clear parameters of expected behaviours and backed up by the necessary support and assistance to sustain these behaviours. Thus, no single method will be successful in isolation, and a mixed-method policy approach will be required. Further quantitative analysis of the TPB results will add insight for determining the most relevant and powerful levers for policy intervention.

Conclusion

Our study highlights that farmers are heterogenous in their views and understanding of managing and protecting native biodiversity on-farm and numerous wide-ranging advantages flowing from managing biodiversity were raised. Disadvantages and barriers clustered around costs, workload,

and lack of time, resourcing and knowledge to undertake pro-biodiversity management practices. There is a clear need for a greater input of expertise and practical and financial assistance to assist landowners and support policy implementation. Courageous policy and industry leadership are required to accompany support packages to ensure protection of existing biodiversity on-farm and direct the needed shift from current practices to improving practice as part of a more integrated approach to securing nature-rich landscapes. Without this, biodiversity outcomes will remain at the whim of individuals who, even with the inclination and will, often lack required knowledge and capacity.

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