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RESEARCH ARTICLE

Giving stakeholders a voice in governance: Biodiversity priorities for New Zealand's agriculture

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Abstract

1. Mainstreaming biodiversity across government and society is recognised by international policy as critical to achieving positive conservation outcomes. With 'participatory governance' increasingly being applied to achieve collective action in conservation, there are growing calls to critically review such processes to capture their complexity and manage for emergent outcomes.
2. This paper critically reviews a case study, aiming to give a broad range of stakeholders a voice in setting biodiversity priorities for New Zealand's agricultural landscape, in relation to four principles for knowledge co-production in sustainability: context-based, pluralistic, goal-orientated and interactive.
3. Aiming to facilitate an inclusive but rapid participation process, while not overburdening those willing to participate, three pathways for engagement were offered. Stakeholder participants were recruited from public, private and civic sectors involved in managing New Zealand's farmland biodiversity.
4. An initial scoping exercise helped elevate biodiversity groups and management actions distinct to New Zealand's social and environmental context. Online surveys then gave stakeholders, from a diverse range of roles and sectors, a nationwide voice to express their own biodiversity interests and needs; these were reviewed by an advisor panel to reach consensus on final priorities that reflected the biodiversity outcomes that matter most to stakeholders involved in managing New Zealand's agricultural landscape and the management practices they considered most relevant to achieving those outcomes.
5. This knowledge co-production process delivered multiple gains that would not have been achieved had a more traditional science-based process been applied, such as wide stakeholder engagement, identification of a tangible starting point, mitigation of bias or conflict risks, enhanced researcher and practitioner capabilities and a shared understanding of the opportunities and challenges for future development.
6. Institutes addressing conservation challenges within local contexts need to: be 'boundary-spanning' to manage cross-scale influences and enable desired conservation behaviours; plan explicitly for the substantial effort required to overcome

existing power hierarchies and facilitate transparent and structured decision processes that deliver social justice; better capture the relational values of nature to more successfully leverage peoples' connection to nature in conservation policies and practices; and incorporate wider environmental (e.g. biosecurity), social, economic and political considerations.

KEYWORDS
agriculture, biodiversity, democratic process, governance, management actions, participatory process, power, prioritisation

1 | INTRODUCTION

Mainstreaming biodiversity as an issue of policy concern across government and society (i.e. achieving 'collective action'; Pretty & Smith, 2004) is recognised by international policy as critical to achieving positive conservation outcomes (e.g. Strategic Goal A in the Aichi Biodiversity Targets). Conservation is value based, with biodiversity having different meanings, significance, interests and needs to different actors involved in its management (Pascual et al., 2017). Thus to successfully reconnect people with nature, conservationists need to recognise that their motivations for caring for biodiversity are not universally shared; instead a better understanding of the different actors involved is needed, working with all actors to enhance how they value it (Buijs & Elands, 2013; Chan et al., 2016; Fischer & Young, 2007; Folke et al., 2011; Smith et al., 2020). However, stakeholder voices have typically only been weakly and indirectly heard. This contrasts the growing pressure to make direct dialogue with stakeholders an integral and normal part of science-based decision-making rather than an optional extra (Irwin, 2006; Reed, 2008; Roux et al., 2006; van der Hel, 2018).

'Participatory governance' is increasingly being applied across a variety of policy areas to help achieve collective action, marking a shift away from top-down expertise or centralised coercion models (Fung, 2015). This recognises that benefits can be accomplished from collective intelligence in addressing complex issues (Woolley et al., 2010), drawing not only on expertise and capacity across different disciplines, and public, private and civic sector organisations, but also from citizens themselves (Fung, 2015; Irwin, 2006; Norström et al., 2020; Sutherland et al., 2020). However, to achieve good governance outcomes, participatory processes need to be carefully shaped and designed (Fung, 2015; Irwin, 2006; Takacs, 2020). Participant selection, methods of communication and decision-making, and empowerment are critical design components. Making clear the intention of engagement, and the pathway to delivering outcomes that are meaningful to the participants are also important (Norström et al., 2020). In addition, other factors driving innovations in participatory processes include increasing constraints on the public sector as well as advances in digital technology making information more accessible, enabling more diverse co-production processes, and delivering enhanced contributions (Bonney et al., 2014; Fung, 2015; Sutherland et al., 2020).

To mitigate the risk of failure despite best intentions, where participant frustration, cynicism and apathy are not only detrimental to the current initiative but also to participatory engagement processes more broadly, Irwin (2006) calls for the critical review of operationalised participation processes to evaluate the lessons learnt from constructing them in different contexts. In addition, Norström et al. (2020) call for the better monitoring and evaluation of 'co-production processes' that capture complexity and manage for emergent outcomes. Here we respond to these calls, outlining our case study application of a collaborative priority-setting process for informing societal decisions in conservation policy and practice (Sutherland et al., 2011), and critically evaluating the implementation of our process to highlight the lessons learned for both our case study and for our understanding of such processes that are represented by the assessment frameworks employed.

Our case study goal was to give a broad range of stakeholders involved in managing New Zealand's agricultural landscape a voice in setting farmland biodiversity priorities that reflect the biodiversity outcomes that matter most to them and the management practices they consider most relevant to achieving those outcomes. This priority-setting process represented the first step in the development of an evidence-based tool for biodiversity assessments on New Zealand farms (MacLeod et al., 2018; MacLeod et al., in press).

Our process evaluation drew on two frameworks. First, recognising the challenges associated with empirically evaluating such processes, Rowe and Frewer (2000) recommend criteria to determine if processes are likely to be acceptable to the wider public and ensure they take place in an effective manner. Second, Norström et al. (2020) have proposed four principles for knowledge co-production in sustainability: context-based, pluralistic, goal-orientated and interactive.

2 | CASE STUDY METHODS

Our process followed four phases for collaborative priority setting (informed by Sutherland et al., 2011): (a) defining and designing the project; (b) recruiting and engaging stakeholders; (c) making decisions to finalise priorities; and (d) disseminating and implementing results (Figure 1). The project was coordinated by a core team with skills in ecology, communication and facilitation, supported

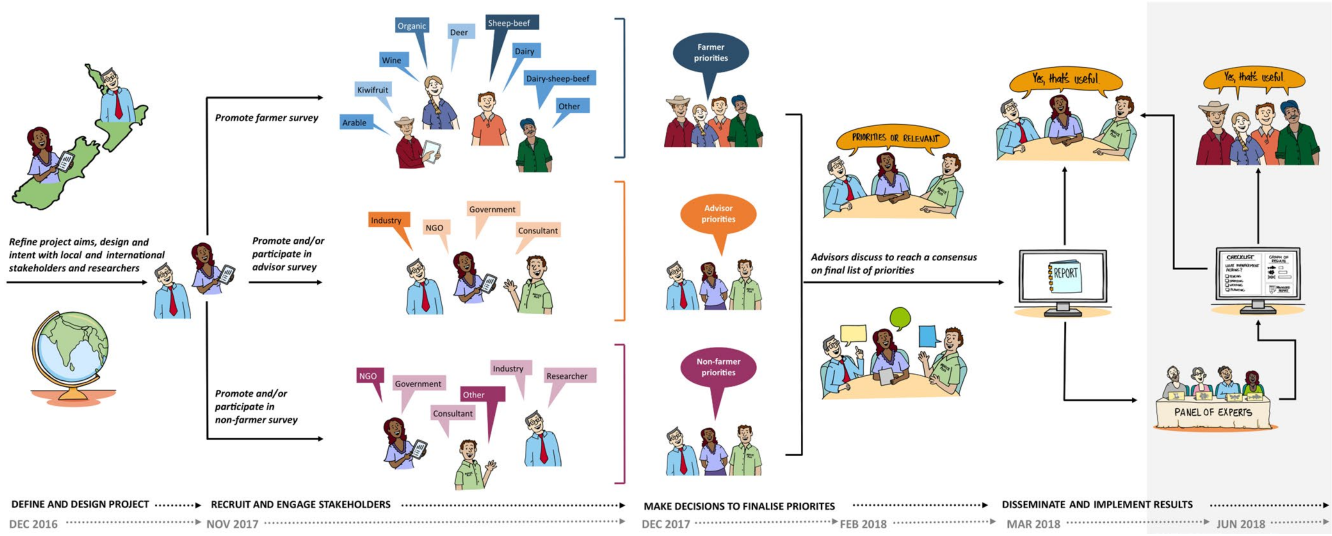


FIGURE 1 Four collaborative steps, and project timeline, undertaken to identify biodiversity priorities for New Zealand's agriculture. Shading of the rectangular speech bubbles is roughly proportional to the number of respondents (Tables S3.3 and S3.4). Grey shading indicates tasks that are not explicitly covered in this paper but contributed to the goal of disseminating and implementing the results as part of the subsequent development of a tool for biodiversity assessments on New Zealand farms

by expertise in agri-business, socio-ecology, solution scanning and graphics recording. The underlying structure of the process was derived from the design of the Cool Farm Biodiversity metric, an online biodiversity tool for farm-scale assessment of biodiversity management, designed to apply to farms anywhere in the temperate forest biome (Cool Farm Alliance, n.d.). This tool identifies a priority set of management actions and species groups, and scores them according to a combination of expert judgement and scientific evidence. Once the project scope and design were finalised, social ethics approval was secured from Manaaki Whenua – Landcare Research, New Zealand's national environmental research institute, which led the project (application number: 1718/06). Participation in our research was based on written informed consent through voluntary submission of the online surveys (Brandt et al., 2017) and email acceptance of the workshop invitations.

2.1 | Defining and designing the project

In the early stages of project development, input from local and international stakeholders and researchers was actively sought to help refine project aims, design and intent, to begin to build the key partnerships and to pilot test some resources (Supporting Information S1). Based on this consultation, the project aim was defined as identifying the biodiversity outcomes that matter most to stakeholders involved in managing New Zealand's agricultural landscape, and the management practices they consider most relevant to achieving those outcomes. It aimed to engage a diverse group of stakeholders (including across public, private and civic sector organisations) in a robust, rapid and inclusive prioritisation process, without overburdening those willing to participate. Specifically, it aimed to deliver a stakeholder-prioritised list of biodiversity groups and management actions that ensured: (a) relevance to diverse interests and needs across a range of stakeholder roles, agricultural sectors and spatial scales (including meeting international market and local reporting requirements); (b) broad coverage of management issues (rather than being an in-depth assessment of a few specific management concerns); (c) a manageable number of priorities was met (*c*. 10 biodiversity groups and *c*. 35 management actions); and (d) key issues requiring follow-up discussion were documented. The intent for generating these prioritised lists was twofold: to inform development of a biodiversity assessment tool for New Zealand farms, and to make the findings available for any interested practitioners, policymakers and researchers to use for their own needs.

To ensure that stakeholder priorities for biodiversity management were objectively determined, our first step was to systematically generate candidate lists of biodiversity groups and management actions of potential value or relevance in the New Zealand farming context (Sutherland et al., 2014). These candidate lists were compiled independently of any perceived value or effectiveness by the researchers (Supporting Information S2). This was to ensure the widest set of possible biodiversity groups and management actions was considered by stakeholders and provided transparency about what was deferred for future developments and why (Sutherland et al., 2014).

These candidate lists were then used to inform the design of online surveys for evaluating stakeholders' biodiversity priorities (Supporting Information S3). Aiming to facilitate an inclusive but rapid participation process, these surveys were tailored for three target audiences, taking into consideration their respective roles. The 'advisor survey' was an intensive prioritisation exercise requiring up to half a day to complete, with personalised invitations sent (via the SurveyMonkey platform) to those who signalled their interest in participating. The other two surveys were administered via a single online link (on the SurveyMonkey platform), with the content tailored according to whether the respondent self-identified as a farmer or non-farmer; both were open to any interested individual and required up to 15 min to complete.

2.2 | Recruiting and engaging participants

A link to the farmer and non-farmer surveys was embedded on the project webpage, alongside other supporting resources (Table S3.1). Bearing in mind key factors expected to influence engagement behaviour (Behaviour Insights Team, 2014; Darnton & Evans, 2013), these resources were designed to: (a) make it attractive and easy for stakeholders to engage with the project, understand its intent and promote it via their own networks; (b) create a sense of collective action by publishing online updates on the project's activities and stakeholder engagement; and (c) ensure participants could readily see the value of their contributions by providing brief and timely results summaries.

A purposive sampling approach was used to recruit stakeholder participants from multiple agricultural sectors, institutes, domains of interest and geographic locations. Three pathways for engagement were offered: participate in the short online surveys, promote the project and short surveys via their own social networks and/or join the advisor panel to participate in the more intensive prioritisation process (Figure 1). Email invitations were sent to 38 organisations, including 19 industry bodies, 11 local or central government agencies, four non-government organisations and four consultants or researchers' to conform to Table S3.2. Most organisations were contacted via known champions (70%), but others initiated via recommended secondary sources (20%), with emails sent to at least 70 individuals in total.

2.3 | Making decisions to finalise priorities

Once the online surveys were completed, the project's core team summarised the results (Tables 1 and 2) and provided a preliminary classification of priorities. Advisors were then invited to a 1-day workshop to review the results and reach a consensus on a finalised list of priorities. Invitations were sent to 39 people from 27 organisations; invitees included all those who had confirmed their interest in the initial advisor survey (Table S3.3). Of the 14 new people contacted, most were suggested as alternative or additional contributors by existing advisor contributors (some of whom were unable to attend), but a few were from central government agencies not captured in the original recruitment round. To optimise the likelihood of workshop attendance, the event was held at a central location (hosted by the Ministry for the Environment), with a standard contribution towards travel costs available on request for all panel participants. The latest results were circulated to the advisors via email before the workshop and again after the event, to give everyone plenty of time to review the content and ensure that those unable to attend had an opportunity to provide additional input via email, telephone or in person.

2.3.1 | Preliminary prioritisation classification based on survey results

Based on an evaluation of the summary metrics derived from the online survey results, each candidate biodiversity group (Table 1) and management category (i.e. group of similar management actions; Table 2) was classified as a top, medium or low priority. Top-priority biodiversity groups were those highly ranked overall in the advisor, farmer and non-farmer surveys, and/or those broadly recognised as a priority across the four advisor roles (industry, government, non-government agency and consultants), nine farmer sectors and six non-farmer roles. Top- and medium-priority management categories were highly ranked in the advisor survey, with broad representation across roles, and were commonly mentioned in the farmer and non-farmer surveys, with broad representation across sectors and roles respectively. Each candidate management action was classified as being of high, medium, low or no relevance based on per cent thresholds of responses to the online surveys (Tables 1 and 2). The thresholds for the relevance classes were determined by looking at histograms of the frequency with which a candidate action was selected or listed by all respondents, as well as within roles for the advisor survey, within sectors for the farmer survey and within roles for the non-farmer survey (Table S6.1).

2.3.2 | Finalising a list of prioritised components

For the concluding prioritisation workshop, the core team prepared a series of presentations to refresh attendees on the project intent, preliminary findings and the prioritisation process (Table S3.1).

The workshop was structured to streamline the list construction process using summarised results from the advisor, farmer and non-farmer surveys. Finalisation of biodiversity groups was made through three steps: (a) confirmation to include the top-priority groups identified by the surveys; (b) confirmation to defer for future developments the low-priority groups; and (c) discussion of which, if any, of the medium-priority groups should be included. Finalisation of management actions was made through three similar steps: (a) confirmation to include the higher relevance management actions within the top- and medium-priority management categories identified by the surveys; (b) confirmation to defer for future developments the lower relevance management actions within the top- and medium-priority management categories; and (c) confirmation to defer for future developments all actions within the low-priority management categories.

The facilitator, who was responsible for leading an inclusive and deliberative discussion to prioritise the biodiversity group and

TABLE 1 A preliminary classification of biodiversity group priorities for management in New Zealand's agricultural landscape was reviewed by 23 advisors from 18 organisations (via a workshop discussion or email) to recommend a finalised list of 10 priorities. This classification was derived from the online engagement results: (1) an advisor survey, where participants (IND = industry, GOV = government, NGO = non-government organisation and CON = consultant) ranked 18 biodiversity groups according to their reporting needs or common expert and policy recommendations (see Figure S4.2 for number of participants by role); (2) a farmer survey, where participants selected up to five biodiversity groups they were interested in enhancing on their farms (see Table S3.4 for number of participants by sector); and (3) a non-farmer survey, where participants selected up to five biodiversity groups they were interested in enhancing on farms (see Table S3.4 for number of participants by role). See footnotes for definitions of each ranking metric and key discussion points relating to each biodiversity group

		Online engagement results									Workshop results
		Advisor survey ($n = 22$)					Farmer survey ($n = 109$)		Non-farmer survey ($n = 80$)		Advisor ($n = 23$)
			Priority by role[b]								
Preliminary priority classification	Biodiversity group	Overall Rank[a]	IND	GOV	NGO	CON	Overall rank[c]	Priority by sectors[d]	Overall rank[c]	Priority by roles[d]	Final recommendation
Top priority	Native bush plants	1	●	●	●	●	1	100%	1	83%	Include
	Native wetland and aquatic plants	2	●	●	●	●	6	55%	2	83%	Include
	Native grassland plants	3	●	●	●	●	12	11%	5	50%	Include
	Native forest birds	4		●		●	4	100%	3	83%	Include
	Native birds of open habitats	5	●		●	●	5	66%	8	33%	Include
	Wetland birds	6		●		●	7	55%	4	66%	Include
	Soil life	10	●		●		2	100%	9	50%	Include
	Beneficial invertebrates	11	●				3	77%	6	50%	Include
Medium priority	Native conservation invertebrates	7			●		9	11%	11	33%	Defer[e]
	Native aquatic animals	8		●			11	0%	7	33%	Include[f]
	Lizards and geckos	9					10	0%	10	33%	Defer[g]
	Livestock, crop and variety	14					8	33%	15	0%	Include[h]

(Continues)

TABLE 1 (Continued)

Preliminary priority classification	Biodiversity group	Online engagement results: Advisor survey (n = 22): Overall Rank[a]	Priority by role[b]: IND	GOV	NGO	CON	Farmer survey (n = 109): Overall rank[c]	Priority by sectors[d]	Non-farmer survey (n = 80): Overall rank[c]	Priority by roles[d]	Workshop results: Advisor (n = 23): Final recommendation
Low priority	Bats	12					15	0%	13	0%	Defer[i]
	Introduced grassland plants	13					14	0%	18	0%	Defer
	Introduced woody plants	15					13	0%	17	0%	Defer[j]
	Introduced birds of open habitats	16					16	0%	16	0%	Defer[k]
	Introduced forest birds	17					18	0%	14	0%	Defer[k]
	Game fish	18					17	0%	12	0%	Defer[l]

[a]Overall rank of biodiversity groups by advisors, in order of median rank across all respondents (irrespective of the advisors' roles; Figure S4.1).

[b]Biodiversity group was included in the top six priorities (as identified by the median rank) by specified role, which were classified as industry, government, non-government organisation and consultant (Figure S4.2).

[c]Overall rank, where biodiversity groups were in order of median percentage selection by respondents across all sectors for farmers/growers (n = 9; Figure S4.3) or across all roles for non-farmers (n = 6; Figure S4.3).

[d]Percentage of sectors where the biodiversity group was among the top six selected most commonly by farmers and growers (where responses were grouped into nine sectors (arable, kiwifruit, wine, organic, dairy, deer, sheep–beef, dairy–sheep–beef and other—which included lifestyle blocks, summer fruit, pigs; note that some respondents were in multiple sector categories; Figure S4.4) or non-farmers (where responses were grouped into six roles (industry, government, non-government organisation, consultant, researcher and unspecified; Figure S4.4).

[e]Considered potential for grouping all terrestrial invertebrates (Beneficial insects +Native conservation invertebrates)—determined that useful reporting information might be lost so decision to defer for future development.

[f]Important for iwi as well as governmental policies and public values on water quality; ensure a better balance across biodiversity taxa given strong emphasis on plants and birds within the other priority biodiversity groups.

[g]Rare and iconic; indicator of management success (becoming more visible with predator control).

[h]Valuable to farmers/growers in considering on-farm biodiversity and hold value to overseas consumers/sustainability assessment.

[j]Valuable as habitat, including for native species; but reporting on performance is not essential, so inclusion as aspects of management action checklist is sufficient for now.

[k]Value to consumers, particularly overseas, as NZ populations of certain iconic species are much higher than in Europe.

[l]Value for recreation and indicator of water quality, but already well-monitored by Fish & Game New Zealand, so decision to defer for now.

[l]Rare and iconic; regionally important—not as widely relevant as other groups, so decision to defer.

TABLE 2 A preliminary classification of farmland management action priorities in New Zealand's agricultural landscape was reviewed by advisors from 18 organisations (via a workshop discussion or email) to recommend a finalised list of 40 priorities. This classification of 84 candidate actions grouped into 24 management categories (see footnotes for summary metric definitions) was derived from the online engagement results: (1) an advisor survey, where participants ranked the management categories and selected the most relevant actions (up to three) within each category according to their reporting needs or common expert and policy recommendations; (2) a farmer survey, where participants listed up to five actions currently implemented and up to five actions planned for future implementation to enhance biodiversity on their farms; and (3) a non-farmer survey, where participants listed up to five actions currently implemented or recommended and up to five actions recommended for future implementation to enhance biodiversity on farms. Textual analysis was used to align open responses from the farmer and non-farmer surveys to management categories and actions in the candidate list. See Figure 4 and Table S7.1 for detail on which candidate actions were recommended for inclusion or deferral in the preliminary and final lists of priorities. Black circles indicate the top six priorities (as identified by the median rank) by specified role in the advisor survey; open circles indicate where a management category was ranked highly by a subset of respondents (as determined by the upper quartile) but was not included in the top six priorities for that role. Management actions in the finalised list are depicted as: Affirmed (■), Affirmed but revise (▣), Altered (█), Altered and revise (◙); square brackets indicate actions combined upon recommendation. Asterisk indicates two management categories that were merged (based on advisor recommendations) to 'Agrichemical best practices', with their aligned six management actions modified and combined into four new actions accordingly

Prioritising management categories											**Prioritising management actions**			
Preliminary priority classification	**Category**	**Online engagement**									**Prioritisation workshop**			
		Advisor survey (*n* = 22)					**Farmer survey (*n* = 91)**		**Non-farmer survey (*n* = 58)**		**Preliminary**		**Finalised**	
		Overall rank[a]	**Priority by role[b]**				**Overall rank[c]**	**Priority by sectors[d]**	**Overall rank[c]**	**Priority by roles[d]**	**Include (*n* = 32)**	**Defer (*n* = 52)**	**Include (*n* = 40)**	**Defer (*n* = 44)**
			IND	**GOV**	**NGO**	**CON**								
Top priority	Protect natural habitat	1		●	●	●	7	44%	4	100%	□□	□	■■	■
	Waterway buffers	2	●	●	●	●	3	100%	3	100%	□	□□	■█	■
	Soil integrity and quality	6	●		●		4	77%	8	50%	□□□□	□□□	■■■[▣◙]	■▣
	Provide natural habitat	7	●	●		●	2	100%	2	100%	□□□		▣▣▣	
	Control predators	8	●				6	55%	5	100%	□	□□	▣	■■
	Waterway management	10		●	○		1	100%	1	100%	□□□	□□□	■■■	▣■■
Medium priority	Manage natural habitat	3		●	●	●					□□	□□□□	■■	■■■■
	Control weeds	4	●			●	13	11%	7	33%	□	□□	[▣◙◙]	
	Provide wildlife habitat	5		●			12	11%	14		□	□□□□□□	■	■■▣■▣■
	Control competitors	9	●			●					□		▣	
	Reduce agrichemical non-targets*	11	○		●						□□		▣▣	
	Control ecosystem engineers	14	○								□		▣	
	Agro-biodiversity for biocontrol	15	○		●						□		■	
	Reduce agrichemical use*	16	○				9	44%	9	33%	□□	□□	▣▣◙◙	
	Provide wildlife resources	17					10	22%	13		□	□□□□□	▣	■■■■■
	Farm product diversity	19					8	55%	12	16%	□□□	□□□□	■■■	■■■■
	Woody vegetation	20					5	100%	6	66%	□□□	□	■■■█	
Low priority	Reduce direct mortality	12										□		■
	Protect rare species	13		○			21		18			□		■
	Protect reproductive habitat	18			○	○	22					□□		■■
	Reduce fertilizer use	21		○			15		10	16%		□	◙	
	Artificial habitat provision	22					19					□□□		■■■
	Beneficial mowing or grazing	23					11		11			□□□□□□□□		■■■■■■■■
	Safe areas for wildlife	24										□		■

[a]Overall rank of management categories by advisors, in order of median rank across all respondents (irrespective of the advisors' roles; Figure S5.1).

[b]Management category was included in the top six priorities (based on median rank) by specified role. Also includes management categories ranked highly by a subset of respondents within a role (based on upper quartile; Figure S5.2).

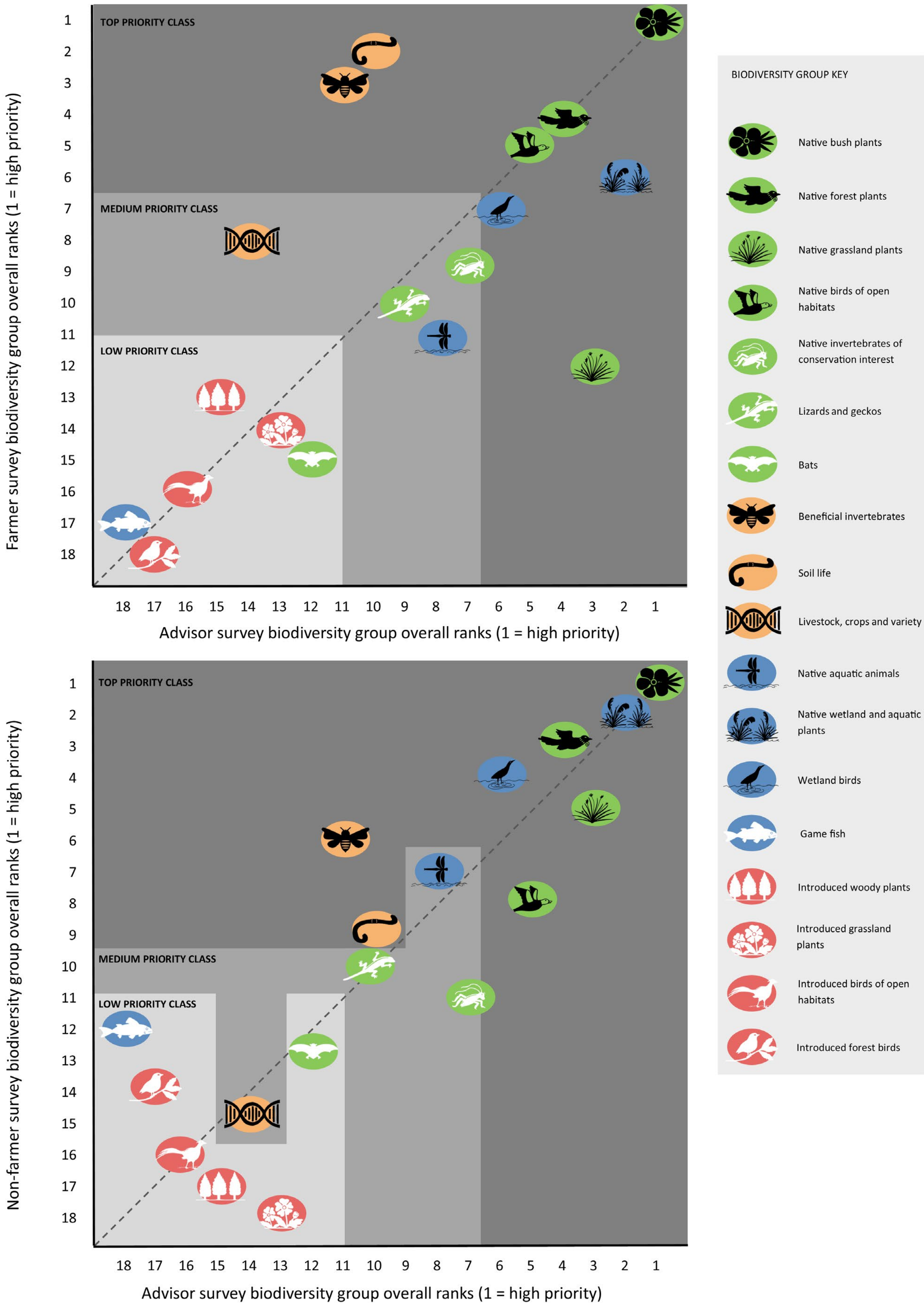
[c]Management categories were ranked in order of median percentage of farmer respondents across all sectors ($n = 9$; Figure S5.3) or non-farmer respondents across all roles ($n = 6$; Figure S5.3) who listed an aligned management action as currently implemented or planned for future implementation on farms.

[d]Percentage of sectors (Figure S5.4) or roles (Figure S5.5) where actions aligned to the management category were among the top six most commonly listed.

management action lists, was supported by two researchers acting as co-facilitators: one systematically presenting the survey results for each biodiversity group and management action to flag those for potential removal or more in-depth discussion; and another recording the live discussion. Both researchers were also available as required to seek clarification from the workshop attendees on key points, or to help translate the group dialogue to provide tangible outputs. Brief opening and closing presentations were provided by the team's agri-business and socio-ecology experts, respectively, aiming to provide participants with insights on the broader context and implications of the project.

2.4 | Disseminating and implementing results

Detailed reports documenting the process and findings were loaded to a publicly available online data repository (administered by the host organisation; see Table S3.1). Links to these reports were also



TOP PRIORITY CLASS
MEDIUM PRIORITY CLASS
LOW PRIORITY CLASS
Farmer survey biodiversity group overall ranks (1 = high priority)
Advisor survey biodiversity group overall ranks (1 = high priority)
TOP PRIORITY CLASS
MEDIUM PRIORITY CLASS
LOW PRIORITY CLASS
Non-farmer survey biodiversity group overall ranks (1 = high priority)
Advisor survey biodiversity group overall ranks (1 = high priority)
BIODIVERSITY GROUP KEY
Native bush plants
Native forest plants
Native grassland plants
Native birds of open habitats
Native invertebrates of conservation interest
Lizards and geckos
Bats
Beneficial invertebrates
Soil life
Livestock, crops and variety
Native aquatic animals
Native wetland and aquatic plants
Wetland birds
Game fish
Introduced woody plants
Introduced grassland plants
Introduced birds of open habitats
Introduced forest birds

FIGURE 2 Overall ranks for biodiversity groups from the farmer (top) and non-farmer (bottom) surveys versus those from the advisor survey, with preliminary classification of top, medium and low priorities indicated by the different boxes (white, light and dark grey respectively). Black and white icons indicate those included or deferred, respectively, from the finalised list of prioritised biodiversity groups. Dashed lines indicate where the icons would fall if there was strong agreement between the compared surveys' results and distance from the line signals the degree of difference in perspectives. Biodiversity groups are colour coded in relation to four high-level traits: native terrestrial (green), functional (orange), aquatic (blue) or introduced (red)

provided on the project webpage, along with a brief video summarising the results. The results were used to inform the development of a proof-of-concept tool for biodiversity assessments on New Zealand farms (MacLeod et al., 2018); this provided an opportunity to publicise the findings of this study to a wide range of biodiversity experts from institutes across the country as well as farmers and other stakeholders. The resources were promoted to a diverse range of practitioners, policymakers and researchers not directly involved in our project via a series of local and international presentations (Table S8.2). This paper represents another channel for communicating our process and the finalised list of biodiversity priorities to national and international research communities.

3 | CASE STUDY RESULTS

3.1 | Stakeholder recruitment and engagement

Of the 38 organisations contacted, 76% responded, 71% indicated their support and 45% signalled their intent to promote the project among their networks (Table S3.2). Government agencies were least likely to respond or support the project, while industry bodies were least likely to signal their intent to promote it. Of the 38 organisations contacted, 63% confirmed their interest in taking part in the intensive prioritisation exercise. Of the 25 people invited to participate in the advisor survey, 92% completed it; respondents were associated with 22 organisations, covering a range of roles: 13 industry bodies (including five horticulture and arable, seven livestock and one irrigation), three government agencies, two NGOs and four consultants or researchers (Table S3.3). These organisations encompassed multiple domains of interest: agriculture, environment, governance and indigenous values. Most respondents (59%) worked at both national and regional scales, while 27% had a regional and 14% a national focus.

For the farmer survey, the 134 respondents covered multiple sectors (including arable, horticulture, livestock, dairy; Table S3.4) and all New Zealand regions except the West Coast (Figure S3.1). Of the 99 respondents to the non-farmer survey (who covered five professional roles—industry, government, non-government organisation, consultant and researcher—and all regions of New Zealand), 26% worked at both the national and regional scales, while 42% had a regional and 11% a national focus (Figure S3.1; Table S3.4). In each survey, 81% of respondents selected at least one biodiversity group, with 71% of farmers and 61% of non-farmers listing at least one management action; these respondent subsets provided good coverage of sectors and roles, respectively (Table S3.4), and of the regions (Figure S3.1).

The prioritisation workshop was attended by 20 participants from 16 organisations (encompassing eight industry bodies, two government agencies, two NGOs and four consultants or researchers), with prior input (via email) provided by others unable to attend (including an industry body, an NGO and a local government agency; Table S3.3). The post-workshop report was sent out for final review to 31 advisors from 24 organisations (those who participated in the advisor survey or responded to the workshop invitation, including those unable to attend); five organisations provided feedback (Table S3.3).

3.2 | Prioritising biodiversity groups

3.2.1 | Candidate list of biodiversity groups

A candidate list of 18 biodiversity groups incorporating the full suite of biodiversity concepts and values for New Zealand agricultural landscape was scoped (Table 1; Table S2.1). Four key adaptations were made to a list of biodiversity groups from the generic biodiversity assessment tool designed to apply across temperate forest biomes (Cool Farm Alliance, n.d.): (a) adding two native biodiversity groups (bats and lizards), which are frequently cited in New Zealand's state of environment reporting; (b) continuing to exclude terrestrial mammals as a group, as all species are introduced to and considered a pest control issue in New Zealand; (c) reflecting a dichotomy in values for native and introduced species in most biodiversity group delineations, except for wetland birds, soil life and invertebrates (the latter were divided into 'beneficial invertebrates' that contribute to agricultural ecosystem services and 'native invertebrates of conservation interest'); and (d) modifying flora and avian groups to specify four habitat types (open, bush, wetland and aquatic) that were more suitable for New Zealand than the temperate forest biome delineations.

3.2.2 | Participant perspectives on biodiversity group priorities

Overall, biodiversity group rankings from the advisor survey were more strongly correlated with those from the non-farmer survey (Spearman rank correlation; rho = 0.857; $p < 0.001$) than the farmer survey (rho = 0.699, $p = 0.002$; Figure 2). Across the three surveys, there was general agreement that priority needed to be given to at least two groups each of native terrestrial and wetland/aquatic biodiversity, with introduced biodiversity groups being given lowest priority. Farmers also gave high priority to biodiversity groups likely to support production, especially beneficial insects and soil life.

Only two biodiversity groups were identically ranked across the three surveys: native bush plants as the top priority (1st) and introduced birds of open habitats as a very low priority (16th). The only other match in rankings was for native wetland and aquatic plants, which were ranked the second top priority by the advisor and non-farmer surveys.

The top three biodiversity groups identified by each of the three surveys encompassed the priorities for 80% or more of each survey's respective roles or sectors (Table 1). Of the nine sectors within the farmer survey, most agreed that functional biodiversity was a priority but just over half considered wetlands and aquatic biodiversity groups to be a priority.

3.2.3 | Finalised list of biodiversity group priorities

The finalised list of prioritised biodiversity groups included the eight top priorities and two medium priorities from the preliminary classification (Table 1; Figure 2). It included seven native and three functional groups, encompassing the top six biodiversity groups for each of the three surveys and the priorities for a third or more of the roles or sectors in at least one survey (Table 1).

Two biodiversity groups were outliers in the medium-priority class for non-farmers and advisors (Figure 2); this was because the corresponding farmer rankings effectively upweighted domestic biodiversity (livestock, crop and variety), but downweighted native aquatic animals. Native aquatic animals were selected for the finalised list because they: (a) are important for Māori iwi (New Zealand's indigenous tribes); (b) align well with current government policies and public values on water quality; and (c) help facilitate a better balance across taxa, given the strong emphasis placed on flora and avian groups among the other priorities. Domestic biodiversity was included in the finalised list because it was considered valuable to farmers as well as for overseas consumers and sustainability assessments.

Eight biodiversity groups were deferred (Table 1), with a recommendation to consider in the future adding bats, lizards and geckos, or other groups (mainly introduced birds and plants) with potential regional, contextual or international markets importance.

3.3 | Prioritising biodiversity management actions

3.3.1 | Candidate lists of management actions

A candidate list of 84 farmland management actions in 24 categories (each containing one to eight actions) were identified as potentially relevant to enhancing biodiversity in the New Zealand farming context (Table S2.3). An evaluation of this list in the context of both international and New Zealand biodiversity assessments highlighted the areas of both overlap and distinction but identified no large gaps (Figure 3). Fifty-eight per cent of the actions aligned with the Cool Farm Biodiversity metric (Cool Farm Alliance, n.d.), 30% with the Food Agriculture Organisation's Sustainability Assessment of Food and Agriculture for Smallholders survey, 42% with a local farm sustainability assessment tool for Māori Rūnanga (Indigenous subtribes), trusts and businesses, 36% with conceptual environmental targets for farms participating in a local irrigation monitoring scheme and 21% with a national survey of rural decision-makers in 2017 (Figure 3). Sixteen management actions in our candidate list (19%, encompassing 12 management categories; Figure 3) did not overlap with any of the comparison farmland management questionnaires.

Management actions specified in the farmer and non-farmer surveys aligned to 92% and 79% of the candidate management categories, respectively (92% when considered together), and to 48% and 42% of the candidate actions respectively (55% when considered together). Of a total of 1,003 individual action responses received (59% from farmers and 41% from non-farmers), 18% could not be assigned to any candidate management categories or actions; 13% did not meet the criteria established in scoping candidate components (e.g. policies or initiatives implemented by governing bodies rather than actions implemented by a farmer/grower directly on their land) and 5% were not detailed enough to accurately assign or represent actions other than those in the candidate list.

3.3.2 | Participant perspectives on management actions

Only one management category (waterway buffers) ranked consistently among the top five in all three surveys (Table 2). Of the advisors' remaining four top categories, none overlapped with the farmers' top five and only one with non-farmers' (protect natural habitat). 'Waterway management' and 'provide natural habitat' were ranked as the top two categories by both farmer and non-farmer surveys. Six additional categories were ranked among the top five in individual surveys: 'soil integrity and quality' and 'woody vegetation' by farmers; 'control predators' by non-farmers; and 'manage natural habitat,' 'control weeds' and 'provide wildlife habitat' by advisors. Management categories within each survey's top five reflected the priorities of most farmer sectors and all non-farmer roles, but were less representative of the advisor roles' priorities, as these were more patchily distributed (Table 2). In all three surveys, priorities of individual sectors or roles were captured by their respective top 13 categories. Five additional categories, which were a high priority for a small subset of individuals within a given advisor role, were flagged; this was to take into account the high variance in ranks among respondents and ensure all the highest priority categories were captured (Figure S5.2).

Of the 84 candidate management actions, 28 were classified as highly relevant across advisors, 14 as medium and 16 as low (Figure 4). For those actions classed as having high or medium relevance across advisors, all were relevant to all four advisor roles (i.e. having at least a low relevance class per role) except 'natural

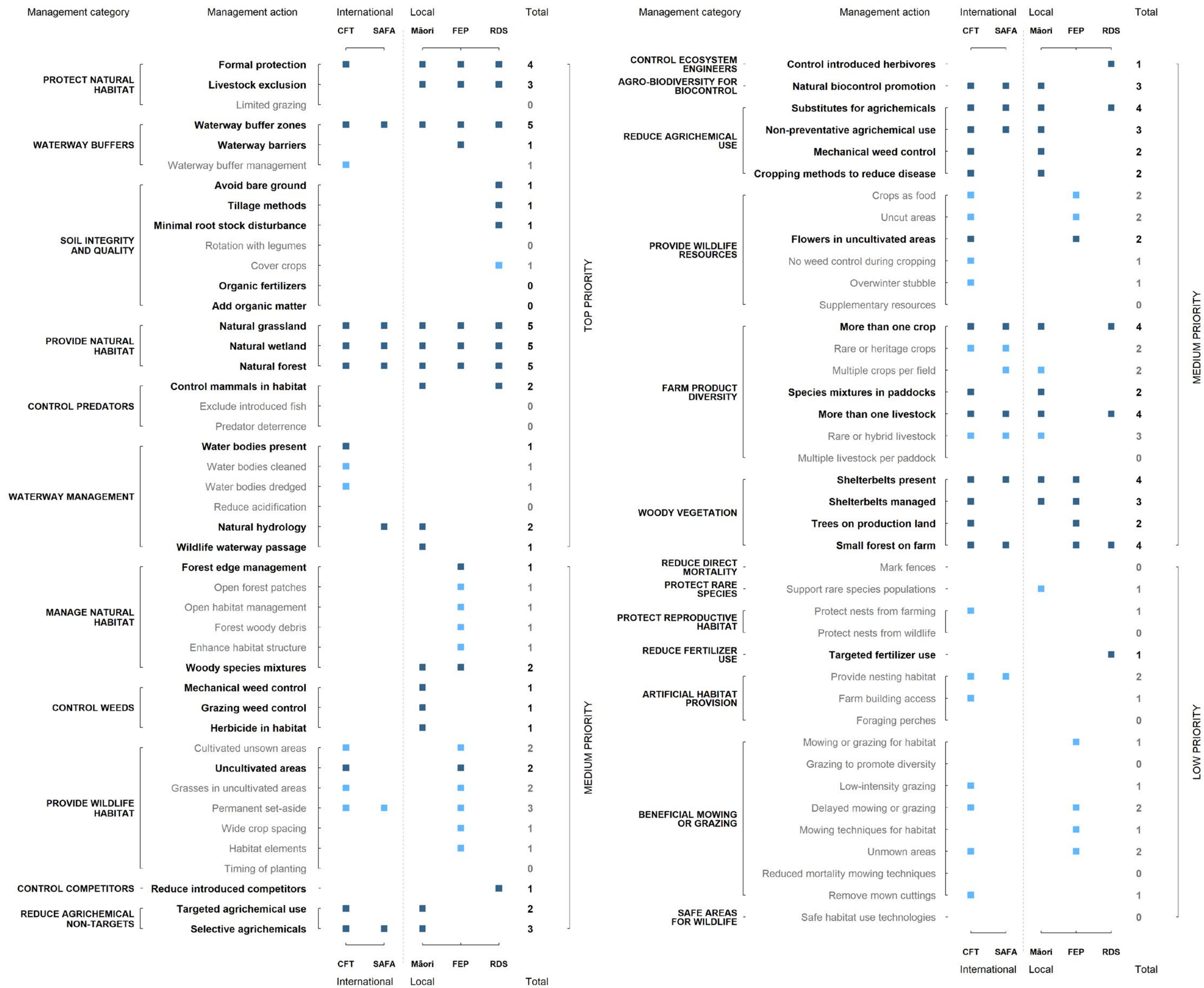


FIGURE 3 Overlap of the 84 candidate farm management actions with international and local schemes (as indicated by the squares, where CFT = Cool Farm Tool; SAFA = Food Agriculture Organisation's Sustainability Assessment of Food and Agriculture for Smallholders survey; Maori = a local farm sustainability assessment tool for Māori Rūnanga (Indigenous subtribes), trusts and businesses; FEP = conceptual environmental targets for farms participating in a local irrigation monitoring scheme; RDS = a national survey of rural decision-makers in 2017) and the total number of schemes each action overlaps. Actions are ordered by their respective management category's priority classification (Table 2), with bold font and dark blue squares indicating those in the finalised prioritised lists (see Table S7.1 for full description of actions)

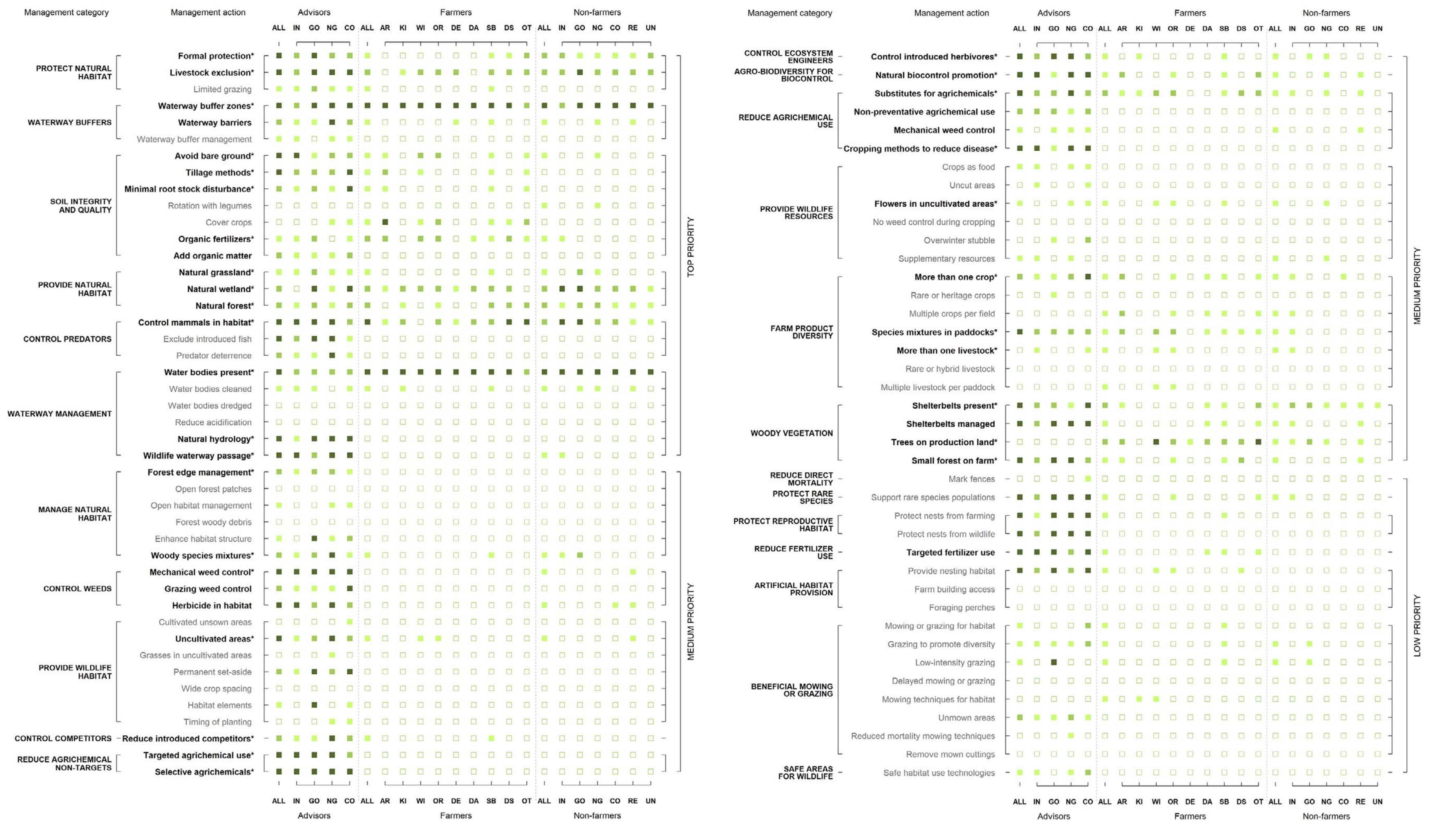


FIGURE 4 Relevance classes for 84 candidate farm management actions according to the advisor ($n = 22$), farmer ($n = 91$) and non-farmer ($n = 58$) surveys: high, medium, low or not (dark, medium and light green and blank squares respectively; see Table S6.1 for details on relevance classes). For each survey, classifications were for 'ALL' responses and by role (IN = industry, GO = government, NG = non-government organisation, CO = consultant, RE = researcher, UN = unspecified) or sector (AR = arable, KI = kiwifruit, WI = wine, OR = organic, DE = deer, DA = dairy, SB = sheep–beef, DS = dairy–sheep–beef, OT = other). Actions are ordered by their respective management category's priority classification (Table 2), with those recommended for inclusion in the preliminary and finalised prioritised lists indicated by an asterisk and bold font respectively (see Table S7.1 for full description of actions, workshop discussion points and those actions recommended for combination and/or alteration)

wetland', which was relevant to three roles. Actions identified as highly relevant across farmers (waterway buffer zones, water bodies present and control mammals in habitat) were among those most relevant across advisors and non-farmers, as well as to a broad range of roles/sectors within each survey (Figure 4). Of the seven actions classed as having medium relevance across farmers, only two (trees on production land and organic fertilisers) did not overlap with those of medium or high relevance across advisors or non-farmers. Twice as many actions were classed as low relevance across farmers and non-farmers compared to across advisors (30 and 28, respectively, cf. 14); for farmers, this subset included seven actions of medium or high relevance to one or more sectors, while for non-farmers it included four actions of medium relevance to one or more roles.

3.3.3 | Finalising a list of relevant actions

Forty of the 84 candidate management actions were included in the finalised list of priorities. All were aligned to management categories identified in the preliminary classification as top and medium priorities, except one (targeted fertiliser use; Table 2; Table S7.1; Figure 4). Each of the top-priority categories (protection or provision of natural habitats, waterway management or buffers, soil integrity and quality, and control of predators) were ranked among the top six in at least two of the three surveys. They also encompassed the top priorities for a range of stakeholder roles and sectors (i.e. priority by roles or sectors metrics were ≥50% in at least two surveys). The medium-priority management categories were generally ranked within the top 15 in at least one survey and in the top six of at least one role group or sector.

The finalised list included all 32 candidate actions recommended for inclusion in the preliminary prioritisation classification (Table 2; Table S7.1; Figure 4), plus an additional eight that were initially deferred (including waterway barriers, shelterbelts managed and targeted fertiliser use). Almost half of the actions in the finalised list were flagged for revision (Table S7.1), with specific recommendations to combine: (a) 'organic fertilisers' and 'add organic matter' into a single action; (b) three actions for controlling weeds in natural habitat into one action encompassing all methods; and (c) two management categories into one ('reduce agrichemical use' and 'reduce agrichemical non-targets' into 'agrichemical best practices') and reframe their associated six management actions into four new ones to reflect principles of Integrated Pest Management (Table S7.1). Another four actions within the draft recommendation for deferral were flagged for revision if under reconsideration or implementation in the future (Table S7.1).

At least a third of the final actions overlapped with the international schemes (55% for the Cool Farm Biodiversity metric; 32% for the Food Agriculture Organisation's survey) and local ones (62% with the tool for Māori Rūnanga, trusts and businesses, 38% with the local irrigation monitoring scheme and 43% with the rural decision-makers' survey; Figure 3). Only two of the 16 actions which did not overlap with any scheme were included in the final list; both linked to soil management ('organic fertilisers' and 'add organic matter'; Figure 3).

3.4 | Engagement with supporting resources and results

The project webpages were viewed 4,668 times in the 18 months following their launch, with 18% of those views occurring in the stakeholder recruitment phase and 15% during the decision-making phase (Table S8.1). The introductory video received 140 views, with 75% of those taking place in the recruitment phase. The results video was viewed 166 times, while the scoping report and workshop resources, which were published on the online DataStore, were accessed 22 and 173 times respectively. These resources were publicised via at least eight presentations to New Zealand practitioners, policymakers and researchers as well as two overseas presentations to international corporations, stakeholders and researchers (Table S8.2).

4 | PROCESS EVALUATION

We review our process in relation to the three key organisational factors that influence public engagement (who participates, how they communicate and make decisions, and the extent of their influence) to consider their impact on advancing three democratic values (effectiveness, legitimacy and social justice; Fung, 2006). Our case study was constructed in such a way that it broadly met the nine criteria recommended by Rowe and Frewer (2000) to determine whether a process was likely to be acceptable to the wider public (*Representativeness*, *Independence*, *Early involvement*, *Influence* and *Transparency*) and took place in an effective manner (*Resource accessibility*, *Task definition*, *Structured decision-making* and *Cost-effectiveness*).

Assessing the success or quality of participatory or co-production processes is challenging, as there are different interpretations of what knowledge co-production means and a wide array of frameworks for evaluating performance of those processes (e.g. Belcher et al., 2016; Fung, 2015; Louder et al., 2021; Rowe & Frewer, 2000). To address this challenge, Norström et al. (2020) propose four principles to underpin high-quality co-production (context-based, pluralistic, goal-orientated and interactive) and account for different perceptions of success among participants.

4.1 | Context-based

The principle of context-based evaluates whether a co-production process is effectively situated within a particular place, set of relationships or a particular issue (Norström et al., 2020). A strength of our process was addressing a context (biodiversity conservation in New Zealand agricultural landscape) that to date has generally been a low-priority relative to other environmental issues, despite recognition of importance for policy and industry (Department of Conservation, 2020; Maseyk et al., 2021; Parliamentary Commissioner for the Environment, 2004; Whitehead, 2017) and ongoing concerns about negative impacts of agricultural intensification on biodiversity (MacLeod & Moller, 2006; Moller, et al., 2008; Parliamentary Commissioner for the Environment, 2004). The voices of the stakeholders involved in farmland biodiversity management have typically only been weakly and indirectly heard in debates in the local scientific literature about the complexities of biodiversity conservation in this landscape and on where efforts should target (e.g. Lee et al., 2008; Maseyk, et al., 2021; Meadows, 2012; Moller, et al., 2008; Moller, et al., 2008; Rowarth, 2008). This contrasts the growing pressure to make direct dialogue with stakeholders an integral and normal part of decision-making rather than an optional extra (e.g. Ministry for the Environment & Department of Conservation, 2017), as reflected in recent environmental policy (Department of Conservation, 2020; Howard et al., 2020; Minister for the Environment, 2020; New Zealand Government, n.d.).

Another strength of our process was it proactively navigated a wide array of cross-scale relationships, to create relevant but diverse communities of research and practice (Darnhofer et al., 2011; Norström et al., 2020; Figure 1) and empower them to influence our science-based decision-making process (van der Hel, 2018; Irwin, 2006; Reed, 2008; Roux et al., 2006). It required identifying a tangible starting point for our case study that aligned with our local partners' pre-existing goals and objectives (Norström et al., 2020). This was achieved using existing stakeholder resources to inform the design of our prioritisation process, including capitalising on research efforts emerging from the wider project within which our case study was situated, which focussed on developing bespoke sustainability assessment tools tailored to meet specific needs through close and long-term partnerships with Māori Rūnanga, trusts and businesses or individual agricultural sectors (Whitehead et al., 2019, 2020). Furthermore, by accessing existing global protocols, expertise and partnership with business, our case study gained a fast start and was able to direct more research resources towards working with local stakeholders to meet their specific needs and interests.

Our case study worked effectively as a catalyst for raising local awareness of a novel evidence-based tool for farm biodiversity assessments being developed overseas and exploring the level of interest in, and feasibility of, initiating a knowledge co-production pathway for tailoring the tool content to make it more relevant to New Zealand's social and environmental context. Stakeholders confirmed such a tool would be useful for building farmer agency and skills to enhance biodiversity outcomes, with a shared understanding of the opportunities and challenges for enhancing the proof-of-concept tool and its future uptake emerging from the wider project (MacLeod et al., in press). Overall, there was strong support for a collective action approach, with New Zealand securing sovereignty over the tool's governance, for future developments; however, the co-development and resourcing of an action plan will likely need to be catalysed by a boundary-spanning organisation as progress has been diffused since the completion of our case study (Eelderink et al., 2020).

A recognised weakness of our case study was its failure to sufficiently address the cultural context in New Zealand. Although Māori were included in all stages of the process and the wider program, there was no direct integration of a Te Ao Māori (Māori worldview) perspective (recognising the interconnected relationships between people and nature, and the importance of ensuring both thrive) into its design and application. Future developments and initiatives should prioritise giving a stronger and more direct voice to Māori who have privileged knowledge of inter-related relationships between local biological and social communities (Harmsworth & Awatere, 2013; Reid & Rout, 2018, 2020; Takacs, 2020)—as reflected in New Zealand's recently launched environmental strategies (Department of Conservation, 2020; Howard et al., 2020; Minister for the Environment, 2020).

4.2 | Pluralistic

The pluralistic principle considers whether a co-production process successfully facilitates multiple ways of knowing and doing, and avoids reproducing existing power hierarchies (Norström et al., 2020).

4.2.1 | Scoping candidate lists mitigated the risk of biases and conflicts

Using a broad range of resources to scope candidate lists of biodiversity groups and management actions at the outset laid a strong foundation for our prioritisation exercise (Table S2.2; Sutherland et al., 2014). Benefits emerging from this objective 'solution scanning' exercise included: (a) mitigating potential biases or conflicts arising from considering only a narrow set of values (*Resource accessibility*; Midgley, 2016; Sutherland & Burgman, 2015); (b) incorporating key components distinctive to New Zealand's agricultural, environmental and cultural context (*Influence*); and (c) enhancing efficiency and transparency by having one party collating and documented the candidate lists and tailoring them for different audiences (*Transparency* and *Cost-effective*).

In effect, we held the institutional power (*Influence*) to define the project scope (Irwin, 2001) and make pragmatic choices to deliver a *cost-effective* process that met its intent (Norström et al., 2020). However, a potential weakness emerging from this power dynamic was the failure to meet all participants' expectations (Fung, 2015; Rowe & Frewer, 2000). For example, while our 'solution scanning' exercise captured a diverse range of instrumental and intrinsic values of nature, relational values were only addressed indirectly. Relational values, which reflect the qualities of the relationships between humans and nature (Chan et al., 2016), can be material, experiential, cognitive, emotional or philosophical (Ives et al., 2018). Chan et al. (2016) and Mattijssen et al. (2020) argue that people's connections to nature could be more successfully leveraged to enhance desired biodiversity and social outcomes by integrating relational values more directly into conservation policies and practices. This philosophy underlies the development of New Zealand's recently launched environmental strategies (Department of Conservation, 2020; Howard et al., 2020; Minister for the Environment, 2020), informed by Māori worldviews and knowledge systems (e.g. Reid & Rout, 2018, 2020; Stronge et al., 2020). Furthermore, as our 'solution scanning' focussed on management actions implemented at the farm level, wider environmental, social, economic and political mechanisms were not considered (Sutherland et al., 2014). Some of these were raised by stakeholders responding to our surveys, who recommended actions implemented beyond the farm boundary or alternative mechanisms (e.g. financial incentives), and identified by others as important for incentivising change locally (Maseyk, et al., 2021; Maseyk, et al., 2021).

4.2.2 | Diverse participants

Our priority-setting process successfully drew on a diverse array of perspectives and knowledge systems to mitigate the risk of bias in our tool design (Martin et al., 2012; McBride et al., 2012). It encompassed a broadly *representative* sample of stakeholders involved in managing biodiversity in New Zealand's agricultural landscape, including farmers, growers and other professionals working across multiple agricultural sectors, institutions, domains of interest and geographic locations (Tables S3.2–S3.4; Figure S3.1). However, the contacted stakeholders also held power to shape our participatory process by deciding whether to promote our online surveys via their own networks and, if so, how widely and to whom (Figure 5; Darnton & Evans, 2013; Fung, 2006). Consequently, in some sectors and regions only a small number of respondents were recruited and/or they only involved individuals with a strong interest in biodiversity management. Future initiatives should investigate whether strategic use of social media channels and their advertising services could overcome these existing power hierarchies and directly engage more land managers and owners.

Some pragmatic choices were also made about how widely to engage and how intensively to persist in seeking input from laggards (Norström et al., 2020). For example, eliciting responses from institutes with no known contact was challenging and so these

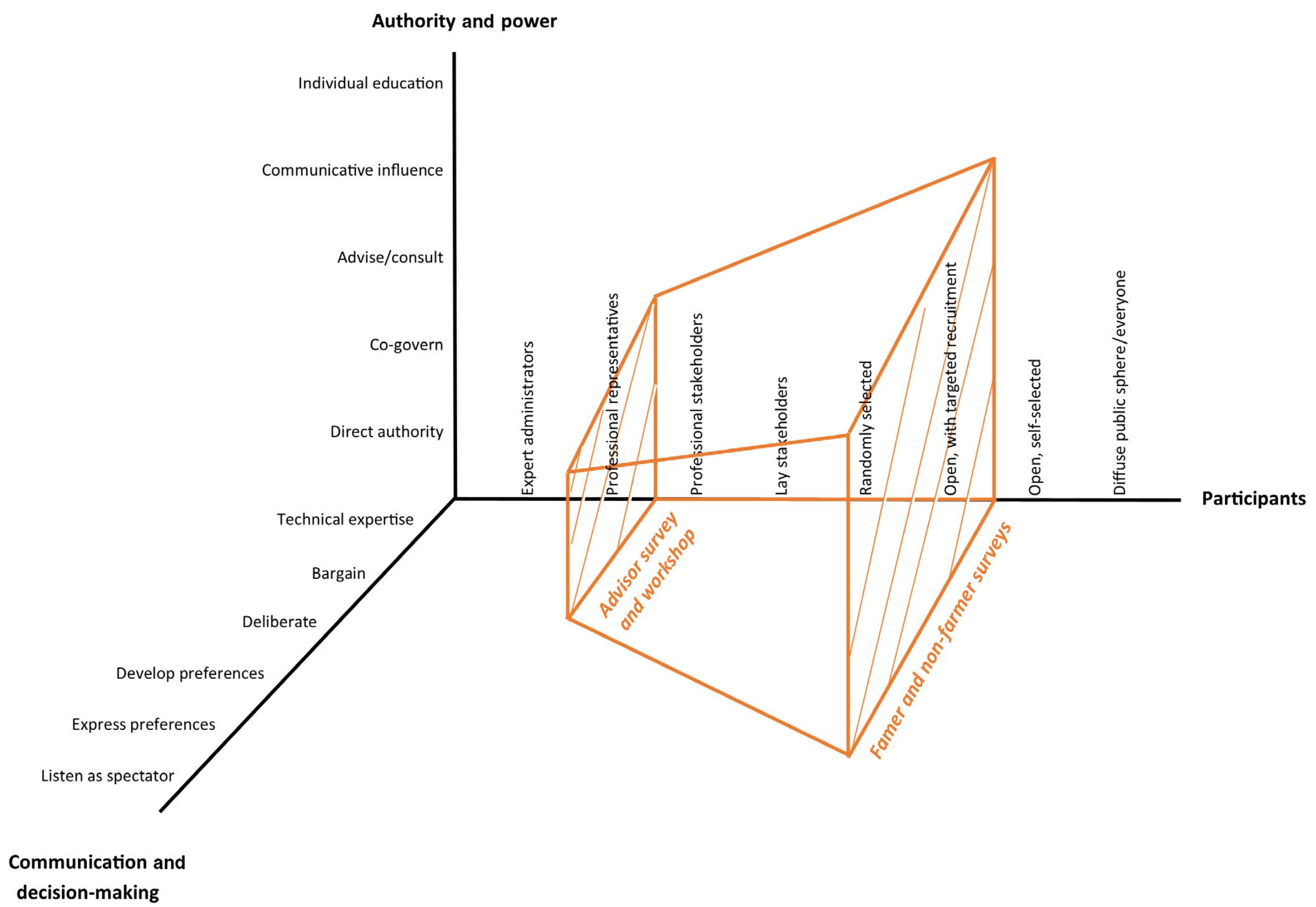


FIGURE 5 Potential design space for organising public engagement, known as the 'democratic cube' (adapted from Fung, 2006), which is determined by three variables: (1) who participates, (2) how they communicate and make decisions, and (3) the extent of their influence over the decision process. Our prioritisation process encompassed the space occupied by the orange cube, with the small panel of advisors working intensively to reach a consensus on the priorities at one end, and that process being informed by the wider, less-intensive surveys of farmer and non-farmer perspectives at the other end

organisations were more likely to be excluded. Furthermore, *early involvement* did not always result in high engagement (Rowe & Frewer, 2000); for example, government agencies, which signalled early interest, were least likely to respond to and support our invitation to participate (Table S3.2). For interested, time-pressured stakeholders, a timely reminder might have nudged them to participate (Darnton & Evans, 2013; Parks, 2020); however, in our case, the skills required to implement such digital nudges were only developed during the project and hence were only applied to the advisor survey.

A weakness of our process was that the New Zealand public, including Māori, and overseas consumers were only indirectly or weakly represented through our stakeholder participants. However, those participants drew on their collective experience working with very large and diverse communities of interest as well as their knowledge of local policy or research developments, including Te Ao Māori (worldview) perspectives (Whitehead et al., 2019, 2020). However, as no information was gathered on participant ethnicity or cultural expertise, we cannot accurately evaluate how well Māori perspectives were represented.

Elsewhere, some have argued that biologists play an important role in giving biodiversity itself a voice, as they are better poised to appreciate its true value than others and hence their voices should be loudest if this leads to 'a more deeply equitable world where individual, community, and nonhuman health and potential is maximised and synergized' (Takacs, 2020, p. 54). However, input from biologists was not actively sought in our prioritisation process. This was a conscious decision, as an independent panel of biologists was later invited to evaluate the expected biodiversity benefits derived from implementing the prioritised management actions. Thus, our aim was to decouple the processes of setting biodiversity priorities and evaluating biodiversity benefits.

4.2.3 | Multiple stakeholder perspectives inform decisions on final priorities

Although a *transparent* and *structured* process was envisaged, there were issues applying it in practice. Identifying preliminary priorities was not straightforward. Differences in survey designs led to twice as many actions being classed as low relevance to farmers and non-farmers (cf. advisors; Figure 4); hence, any actions mentioned in the farmer and non-farmer surveys were preferentially weighted over those with similar relevance in the advisor survey. In effect, the different perspectives of each role and sector were given an equal weight when setting the preliminary priorities (*Representative*); a key question, however, is whether all voices in our process should have been equal and if that helped facilitate social justice (i.e. ensuring one party is not disadvantaged over another; Fung, 2006, 2015). Determining how much weight should be applied to different voices contributing to the prioritisation process is an important factor for future consideration (potentially facilitated by a choice modelling exercise; Griener et al., 2014), akin to the debate around the role that citizens should play in the choice of political election systems (Fung, 2015).

Our participatory process endeavoured to give stakeholders a voice in setting biodiversity priorities, but institutions still held the power to shape the communication and decision-making process. For example, by processing the data and identifying the preliminary priorities, the project team sought to represent stakeholder views, thus refracting stakeholder contributions through the research process (Irwin, 2001). Similarly, the professional stakeholders followed a predefined process to debate and reach a consensus on the priorities. While this was a *cost-effective* and *transparent* process, in the short term it provided little opportunity for critical scrutiny outside the immediate advisor panel (Irwin, 2001). Inviting further review from farmers and other stakeholders was planned in subsequent steps of our research project (MacLeod et al., in press).

Encouragingly, at least a third of the finalised actions overlapped international and local schemes (Figure 3), signalling that our process delivered outcomes relevant within these different contexts; notably, strongest alignment (62%) was achieved in relation to the scheme designed specifically for Māori Rūnanga, trusts and businesses, despite this stakeholder group having a relatively weak voice in prioritisation process. Furthermore, two soil management actions not aligned to/with any of our reviewed schemes were also added to the finalised list, reiterating the value of scoping candidate lists to reduce bias.

4.3 | Goal-orientated

The goal-orientated principle evaluates whether the objectives of the co-production process are clearly defined, shared and meaningful to the challenge being addressed (Norström et al., 2020).

4.3.1 | Priority-setting process

Our priority-setting process successfully met the following criteria defined at the outset (*Task definition*), in consultation with others, incorporating: (a) a diverse range of biodiversity values, interests and needs (Table 1); (b) actions implemented across different habitat types within farms and agricultural sectors (Figure 4; Table 2); (c) a realistic volume of material to incorporate into our subsequent tool development; and (d) document any issues requiring follow-up (Table S7.1). By facilitating a collective action approach, our process helped to transcend overly narrow judgements about what is important, widen the boundaries of the issues considered relevant and reach a mutual understanding about the biodiversity priorities that would benefit a diverse range of stakeholders and thus provide a tangible starting point for our tool development (Midgley, 2016). Overall, these influences not only enhance the legitimacy of the final priorities and the likelihood that policies based on them will be more widely adhered to, but also enable the participating stakeholders to envisage pathways for incorporating other biodiversity or sustainability values in the future (Chan et al., 2016; Fung, 2015; Mattijssen et al., 2020; Park, 2020).

While our 'solution scanning' exercise helped elevate biodiversity groups and management actions distinct to New Zealand's social and environmental context (offsetting the influence of global institutes; Boyd, 2020), online surveys gave a wide range of stakeholders a voice to *influence* the final priorities—which were then decided by our advisor panel via a workshop discussion. For example, when the advisor panel was working towards reaching a consensus on the priorities, relational values were often raised to set out the rationale for selecting one biodiversity group over another. For example, functional biodiversity groups were prioritised, not just because these were highly ranked by farmers across all sectors (Table 1; Figure 2), but also because they were recognised as important for supporting farmers' well-being (by enabling them to sustain their livelihoods) and their identities (by fulfilling their roles as long-term stewards of the land; Chan et al., 2016). Conversely, native aquatic animals were prioritised, despite being a medium priority to farmers (Table 1; Figure 2), as they are culturally valuable to Māori (e.g. for mahinga kai or food procurement; Lyver et al., 2017) and important within government policy and public values (Minister for the Environment, 2020). Debate about whether to include endemic, rare and threatened species, such as bats and lizards and geckos, emphasised not just their intrinsic values, but also their importance in contributing to some landowners' sense of place (Williams & Steward, 1998)—through their role as custodians of these species. However, a pragmatic choice was made to defer these latter biodiversity groups for future developments, as they typically have localised distributions and likely to require specialised, species-specific management strategies that will only be relevant to a subset of sectors or regions (Hitchmough et al., 2016; Towns et al., 2001).

Better linkages to relational values of nature were considered valuable for building the 'New Zealand story', a recommended pathway for building stakeholder engagement with our biodiversity assessment tool (MacLeod et al., in press); the goal being to extend care for nature in 'our places' to 'other people's places', through the provision of a more tangible linkage between food consumers and producers in global supply chains (Chan et al., 2016). By better articulating the New Zealand story, suppliers would be in a stronger position to convey to their international markets why an 'off-the-shelf' biodiversity tool designed for overseas farms is not appropriate for their local context. For example, while introduced biodiversity groups were generally ranked low by stakeholders, their importance to overseas markets was discussed; some of these species, which are declining in their native ranges, thrive in New Zealand farming landscapes (MacLeod et al., 2009) but can cause significant damage to arable and horticulture crops (Porter et al., 1994). To address this weakness, it was recommended that future tool developments include a biosecurity module to enable farmers to explore and demonstrate the trade-offs and challenges they face in managing biosecurity and biodiversity outcomes.

4.3.2 | Beyond the priority-setting process

Our case study had a clear pathway to delivering its intended outcomes, which was meaningful to participants (Fung, 2015; Shirk et al., 2012). The intent for generating the biodiversity priorities was met (*Influence*): (a) within a month, the results were available online (Table S3.1); (b) within 4 months, the results were used to design and deliver a proof-of-concept tool for biodiversity assessments on New Zealand farms (MacLeod et al., 2018); and (c) within 9 months, the tool was tested by a wide range of stakeholders including those involved in the prioritisation process (MacLeod et al., in press), with one local government agency signalling that they were already working with farmers to use the tool to develop their farm environmental plans. By working quickly to deliver these subsequent outputs, our goal was to mitigate the risk of stakeholder frustration and disappointment (Fung, 2015; Irwin, 2006; Rowe & Frewer, 2000).

4.4 | Interactions

The interactive principle considers whether the co-production process allows for ongoing learning among actors, active engagement and frequent interactions (Norström et al., 2020). To achieve a prioritisation process that was rapid and inclusive, while not overburdening those willing to participate, multiple pathways for engagement were offered (Figure 1), using digital technology to facilitate *resource accessibility* and participation by a diffuse, diverse and wide range of stakeholders (Fung, 2015; Sutherland et al., 2020). Each pathway represented a different 'trade-off between interpretative flexibility and volume of respondents' (Irwin, 2001). Engagement metrics with our online resources indicated that people were aware of and investigating them, with peaks in activity associated with publicity events such as emails, workshops or seminars (Table S8.1).

The advisor survey involved 22 professional stakeholders (Figure 5; Fung, 2006). Key advantages of this highly structured and intensive survey (*Task definition*) included all participants independently considering the same information (*Transparency*), participants completing the survey on their own or with colleagues in their own time and pace (*Resource accessibility* and *Independence*) and the ability to rapidly summarise and compare results across stakeholder roles (*Cost-effective*). However, some participants found the survey arduous, while others were frustrated as they felt some actions were obviously not relevant or translated for the New Zealand context. While minor language adjustments were made during the survey preparation, a more comprehensive translation was reserved for the prioritised actions (Norström et al., 2020). This highlights another challenge of balancing delivery of a *cost-effective* and *transparent* process, with a positive experience for time-pressured participants.

Our case study involved regular interactions with our advisor panel; however, the nature of these interactions had to be adapted to accommodate individual needs and circumstances (Figure 5; Fung, 2006). For example, some parties were unable to travel to attend workshops so provided input via other communications channels (e.g. email, meetings in person or via the telephone). This increased the transaction costs of engagement, but in some cases helped to facilitate a closer link and more in-depth discussion with the stakeholder. Although the advisor panel was invited to provide feedback on our priority-setting process (via a handout or online survey), few participants responded. Given their significant in-kind contribution to the case study, we did not pursue this further but instead channelled our resources towards advancing the tool development and re-engaging them in the subsequent tool testing phase. By working quickly to deliver these subsequent outputs, our goal was to mitigate the risk of stakeholder frustration and disappointment (Fung, 2015; Irwin, 2006; Rowe & Frewer, 2000).

Our interactions with stakeholders involved in our farmer and non-farmer surveys were more diffuse—relying on third parties and our webpage to facilitate relevant, but typically one-way information flows. These cross-checking surveys facilitated less-intensive input from a diffuse but diverse group of stakeholders, which helped to keep our process manageable. They had 10 times as many respondents (cf. advisors) encompassing multiple stakeholder roles and sectors, and with roughly 80% expressing their biodiversity perspectives (Figure 4; Fung, 2006). With hindsight, we should have provided an avenue for these survey participants (and other interested parties) to sign up to a mailing list so that we could maintain a more direct line of communication with them. In addition, better mechanisms for public engagement would facilitate trust building in the agricultural industry's social licence to operate and better allow influence on consumer behaviours in global supply chains (Chan et al., 2016).

5 | CONCLUSIONS

Our case study adapted a collaborative priority-setting process to show how local conservation initiatives can benefit from cross-scale collaborations, where emerging international research and tools can give a fast start, and learnings can be tailored to meet local needs cost-effectively, especially where the available resources are scarce. By tailoring engagement pathways for different audiences, multiple parties were empowered to add their values, opinions and perspectives (Reed, 2008) which directly influenced the decisions and outcomes of our process (Fung, 2006). This delivered multiple gains that would not have been achieved had a more traditional science-based process been applied (Woolley et al., 2010), such as wide stakeholder engagement, identification of a tangible starting point, mitigation of bias or conflict risks (Midgley, 2016), enhanced researcher and practitioner capabilities and a shared understanding of the opportunities and challenges for future development (MacLeod et al., in press). Together these influences enhance the legitimacy of the final priorities, and raise the likelihood that policies based on them will be adhered to (Fung, 2015; Park, 2020).

Lessons emerging from our process evaluation include:

- Institutes addressing conservation challenges within local contexts will need to be 'boundary spanning' to manage cross-scale influences and create circumstances that encourage conservation behaviours by relevant actors (Abson et al., 2017; Darnhofer et al., 2011; Norström et al., 2020; Ostrom, 2009).
- To help address the 'persistent gap' between information generated by science and that desired by land managers (Sutherland et al., 2011), there is a need to recognise the effort required to overcome existing power hierarchies (Irwin, 2001; Norström et al., 2020), be sympathetic to the time pressures of collaborative process participants, facilitate transparent and structured decision-making processes that deliver social justice and explicitly plan for such.
- Processes should better capture the relational values of nature (including Te Ao Māori perspectives; Harmsworth & Awatere, 2013; Reid & Rout, 2018, 2020; Stronge et al., 2020) to more successfully leverage peoples' connection to nature in conservation policies and practices to deliver desired biodiversity and social outcomes (Chan et al., 2016; Mattijssen et al., 2020).
- Wider environmental (e.g. biosecurity in this instance), social, economic and political mechanisms' considerations need to be pulled in (MacLeod et al., in press; Maseyk et al., 2021, 2021).

Others wishing to apply similar approaches should not overlook the time taken to: (a) build the required capability and the benefits gained from working with experienced collaborators; (b) prepare supporting material that draws on behavioural insights to make it easy, attractive and timely for different audiences to engage without overburdening them (Behavioural Insights Team, 2014; Darnton & Evans, 2013; Scheufele, 2018; Smith et al., 2020); (c) do the necessary groundwork to facilitate as rapid and smooth a process as possible, while also retaining some flexibility to adapt; and (d) critically review the process to recognise that its form and design can have a substantial impact on the level, nature and outcomes of actual engagement (Fung, 2015; Irwin, 2006; Norström et al., 2020; Rowe & Frewer, 2000; Shirk et al., 2012).

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

AUTHORS' CONTRIBUTIONS

C.J.M. led the project and writing of the paper; C.J.M., A.J.B., K.C. and L.V.D. conceived the ideas and designed the methodology; C.J.M., A.J.B. and K.C. implemented the collaborative process; A.J.B. and C.J.M. analysed the data; A.J.B. helped write the paper.

All authors contributed critically to the drafts and gave final approval for publication.

DATA AVAILABILITY STATEMENT

The data presented in this paper are available via the Manaaki Whenua – Landcare Research online DataStore (MacLeod et al., 2021). See Table S3.1 for links to other supporting resources (developed to introduce the project, its intent and design, to facilitate stakeholder input and to communicate the latest results and progress updates).

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SUPPORTING INFORMATION

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