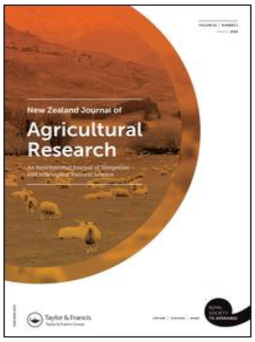

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FORUM PAPER

Progressing the consideration of indigenous biodiversity in farm planning processes in New Zealand

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ABSTRACT

Farm planning processes have long been based on land evaluation, and although this analysis conceptually includes other biotic and abiotic factors beyond just land, they have typically focused on soils and land-use capability. The need to broaden this scope to more explicitly include biodiversity, ecosystem service provision, and sustainability considerations has been internationally recognised. Indigenous terrestrial and aquatic features represent a considerable asset to the farm system yet, to date, farm planning processes in New Zealand have largely failed to account for this natural capital stock and its contribution to the current or future business. Substantial knowledge gaps and lack of empirical data across many biodiversity metrics, limited institutional capacity, and lack of investment and on-going costs, are all factors contributing to the lack of integration of biodiversity considerations in farm planning processes. The net effect is the on-going depletion and degradation of indigenous biodiversity on-farm. We do, however, have an existing mechanism, in the form of 'whole farm plans', that could be utilised to integrate biodiversity natural capital and its management into farm planning and we illustrate the feasibility of this approach using a case study from the Waikato Region.

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Farm resilience; indigenous flora and fauna; natural capital; sustainability; whole farm plans

Introduction

Farm planning is an internationally well-established practice (OECD 2001) for the purposes of describing the farm assets, and capability and production suitability in the context of management of the enterprise to achieve a stated set of goals and objectives (including financial, environmental, social, and animal welfare). Farm plans provide a mechanism to translate farm planning processes into on-farm actions and have been used throughout the world as a policy response to address a variety of resource management issues and environmental externalities associated with food production, an indicator of environmental awareness and practice on-farm, and a tool to help achieve on-farm goals (Kemp 1996; OECD 2001; Manderson et al. 2007). Farm plans have also been explicitly linked with agri-environmental schemes as, for example, prerequisites

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for financial assistance, such as Ontario's Environmental Farm Plan scheme (Robinson 2006).

Agri-environmental schemes are a policy tool designed to encourage land management practices that support and enhance the environment. For example, Australia's Agriculture Stewardship Package designed to help farmers improve on-farm land management practice and reward actions for biodiversity protection (with a price tag of AUS$34 million plus an additional $32.1 million in 2021–2022 for Biodiversity Stewardship, Department of Agriculture 2021), and the European Union's (EU) Common Agricultural Policy (CAP) that includes direct payments for environmental actions on-farm (€41.43 billion in income support to EU farmers in 2019; European Commission 2021). Carefully designed agricultural policies can efficiently deliver environmental performance goals (Lankoski and Thiem 2020) and New Zealand could look to the international experience to better understand how such programmes can most successfully encourage change (see, for example, Baylis et al. 2008; Pannell 2008; Burton and Schwarz 2013; Lastra-Bravo et al. 2015; Ansell et al. 2016; European Court of Auditors 2020; Pannell and Claassen 2020). International lessons will be particularly useful given that production and trade-distorting policy support in New Zealand has been the lowest among the OECD countries (OECD 2020), meaning we have fewer domestic examples to learn from.

In New Zealand, farm planning has traditionally focussed on soil conservation to limit the loss of soil and sedimentation of waterways (Manderson et al. 2007). In recent times, this has expanded to include nutrient management and other water quality considerations via various categories of farm plans (Maseyk et al. 2019) and most recently, the introduction of mandatory freshwater farm plans (Stokes et al. 2021). However, farm planning processes in New Zealand are typically single-issue focused (Maseyk et al. 2019) and have yet to fully consider the contribution of indigenous biodiversity to the farm business despite the clear need to broaden the scope of farm plans to include the provision of ecosystem services and sustainability considerations being recognised (see, for example, FAO 2007; Mackay et al. 2018; Maseyk et al. 2019; Beef + Lamb New Zealand 2020b). This is a fundamental limitation that will restrict the potential of farm plans to deliver sustainable farming and environmental performance objectives. We suggest this needs to be overcome regardless of the policy mechanisms used to support the development and implementation of farm plans in New Zealand.

Indigenous biodiversity (including terrestrial and aquatic species, habitats, and ecosystems) has been much reduced in New Zealand since human occupation (Norton and Miller 2000; Ewers et al. 2006; Walker et al. 2006; Wilmshurst et al. 2008; Myers et al. 2013; Goodman et al. 2014; Joy and Death 2014; Brown et al. 2015; Weeks et al. 2015; Ministry for the Environment & Stats NZ 2018) The country is facing a biodiversity crisis (Bradshaw et al. 2010; Brown et al. 2015) and continues to experience on-going losses of biodiversity and declines in water quality resulting from land-use change and intensification of agriculture (Parliamentary Commissioner for the Environment 2013, 2015; Ministry for the Environment & Stats NZ 2019).

This is of grave concern not just from a conservation perspective. Biodiversity natural capital stocks contribute to the provision of ecosystem services (IPBES 2018), underpinning productive capacity and enhancing on-farm resilience (the ability to withstand and recover from disturbance across socio and ecological dimensions, Darnhofer 2014). The continual depletion of natural capital stocks compromises system functions which underpin regulatory ecosystem services. We are reliant on these services for food production, water security, human health, and wellbeing. Therefore, pro-biodiversity management actions on-farm are an important component of securing long-term sustainability of the farm business and farming communities, and food security; as well as conservation outcomes.

We suggest that integrating indigenous biodiversity into the farm planning process – a current gap – is key to advancing on-farm resilience while also addressing the national biodiversity crisis. In this paper we suggest a starting pathway to support this shift by:

1. Identifying key barriers to integrating biodiversity into farm planning
2. Providing an illustrative example of how biodiversity can be integrated into farm planning using a case study of a 450 ha sheep and beef farm in the Waikato Region

In identifying barriers we focus specifically on key factors associated with broadening the scope of farm planning in New Zealand and do not directly address challenges and barriers to implementing farm plans, such as patterns of farmer adoption and behaviour change. Nor do we provide a detailed review of the various policy mechanisms used in other jurisdictions, such as agri-environmental schemes, which can be used to incentivise and nudge uptake of farm plan implementation. However, these are key aspects that will strongly influence the success of farm planning in New Zealand and are worthy of deep attention. In particular, evaluating the advantages and limitations of linking farm planning to agri-environmental schemes or other policy initiatives, and whether using farm plans assists with achieving additional outcomes and permanence of behaviour change would be a useful undertaking.

Overcoming barriers to integrating biodiversity into farm planning

Currently, farm planning may include indigenous biodiversity, but this typically occurs in a limited way and captured at a broad-scale as 'non-productive' units of the farm (Maseyk et al. 2019). However, integrating the full range of biodiversity considerations into farm planning requires a concerted effort to move past simple mapping exercises and to recognise the influences of land use and management practices on the condition (quality and quantity) and consequent functionality of biodiversity assets. To do this, we suggest a number of real and perceived barriers will need to be overcome as a priority. These barriers span technical, financial, and governance dimensions, but for simplicity, we have grouped them into the following categories, although we note that barriers can operate interdependently and will need to be addressed concurrently. We also suggest that existing literature and future locally relevant studies explaining influences on farmer behaviour and behaviour change will be critical to inform and prioritise policy initiatives to overcome these barriers. In addition, much could be learnt from experiences in other jurisdictions in overcoming similar barriers to implementing more pro-biodiversity practices on-farm (for e.g. Raymond et al. 2011; Raymond and Brown 2011).

Lack of data

A lack of knowledge can constrain decision-making. This can occur in the context of understanding what biodiversity attributes are present on-farm, the ecological values these attributes possess, how these attributes contribute to farm system outcomes, or what is needed to enhance those values. Composition of the biodiversity on-farm is influenced by many factors including climate, topography, past disturbance, biological invasions, competition and chance; as well as land-use practices (Norton and Reid 2013; Death et al. 2015). While the remaining extent of indigenous vegetation on-farm can be explained by the environmental history specific to an area and the past and current land use and management practices on-farm, the composition beyond the dominant plant species is more complex. Patterns and processes influencing aquatic biodiversity can also be readily described in the broad-sense, but can be particularly nuanced at the property/ reach-scale (Death and Joy 2004; Death et al. 2015). Understanding how these factors, and individual knowledge of indigenous biodiversity are operating at the farm and catchment scale will help inform the development of a workplan at both scales and improve the likelihood of successful restoration attempts.

Other important knowledge gaps include necessary on-farm actions to improve provision of important habitat for threatened species at a landscape scale, how these may benefit or impair other farm management goals (e.g. flood management, greenhouse gas emissions); and the influence of spatial configuration on connectivity (matrix, corridors, size and shape of remnants).

The need for additional effort nationally for improved biodiversity state and trend data is also evident (Ministry for the Environment & Stats NZ 2018). While we agree that investing in this additional effort should be a priority, the urgency to address species extinction, sustainability and resilience challenges on-farm is such that we should not continue to delay or side-line, biodiversity considerations on-farm until we have ‘perfect’ knowledge. Existing information is adequate to identify issues at the broad scale, and begin to guide necessary interventions. Like all aspects of farming and conservation, techniques and practices can be adapted and improved as knowledge increases, and to overcome any unintended consequences or unforeseen system-shifts as a result of a management intervention. Gaps at the property scale can be filled at the time of developing a farm plan, by involving the appropriate expertise.

Challenges of connectivity across spatial and temporal scales

Sustained connectivity across space and time is a key component of ecosystem function. Ecological connectivity is influenced by spatial and temporal configuration of species and habitat, patch dynamics, and the impacts of disturbance events, particularly pulse-disturbances (short-term, distinct events such as flood events and drought) (see for example, Townsend 1989; Meurk and Hall 2006; Fuller and Death 2018). These influences on ecological connectivity in turn influence the farm’s ability to assimilate emissions. Incorporating goals and targets within a farm plan that span and connect spatial and temporal scales is extremely challenging, but increasingly critical for improving long-term sustainability of farming and on-farm resilience.

Current institutional practice and capacity

Broadening the scope of farm plans will require additional information and expertise across regional councils, independent farm advisors, universities, and industry groups to sit alongside farmers' knowledge and aspirations for their farms. The need for the combination of farm system expertise and ecological interpretation of impacts of farming on nature is also recognised in international attempts to align farming and conservation (see for example, van der Windt and Swart 2018). The notion that indigenous biodiversity is a separate exercise, removed from farm planning and the overall performance of the farm system needs to be dismantled.

Social barriers

Expanding the scope of current farm planning will require a shift in individual behaviour as well as policy and institutional support structures. Attitudes and behaviours are complex and dynamic (Reddy et al. 2017) and are influenced by a number of factors and motivations (Pannell et al. 2006; Rhodes et al. 2016). The manner in which these factors resonate with individuals is in turn influenced by their beliefs, values, and individual goals which vary greatly (Ajzen 1988; Parminter and Perkins 1997). This needs careful consideration in forming a concerted approach to integrating indigenous biodiversity into the farmed landscape.

Costs

The cost of maintaining and enhancing biodiversity is frequently cited as a disincentive for landowners to voluntarily undertake the task (Maseyk et al. 2021). Further, in New Zealand, the on-going need to control invasive animal pests and weed species in perpetuity is a very real challenge (Clout and Saunders 1995), the corresponding costs of which are often cited as barriers to undertaking more restoration on-farm (e.g. Maseyk et al. 2021).

The non-random distribution of remaining indigenous vegetation (Walker et al. 2006; Cieraad et al. 2015) evokes further arguments that the distribution of costs associated with managing and enhancing biodiversity will be unequitable. The inequity of contemporary land-use restrictions to address historic patterns of loss are likely to be of particular relevance to Māori land because there is a significant area of land remaining in Māori ownership situated in fragile natural environments and that is less accessible or conducive to production. Māori agricultural land is disproportionately on more challenging landscapes (e.g. LUC Class 6–8) with limitations to use because the most fertile land was sold or confiscated (raupatu) as a consequence of colonisation and subsequent legislation and public policy, preventing Māori access to resources and opportunities (Selby et al. 2010; Mikaere 2011). Therefore, care must be taken that policies or other interventions aimed at protecting biodiversity do not further disadvantage the aspirations of iwi, hapū, and whānau.

New Zealand's current policy and regulatory environment makes it seem economically rational for an individual farmer not to engage in voluntary pro-biodiversity behaviours (Craig et al. 2000; Stephens et al. 2016). Aligning policy signals and incentivising conservation is a necessary precursor to recognising and reinforcing good stewardship, alongside shifting perceptions towards recognising that managing and enhancing indigenous biodiversity (including costs associated with sustained suppression of pest species) is an investment in ecological infrastructure that adds to Net Present Value (Bristow et al. 2010; Dominati et al. 2014), rather than being a sunk cost. While there are various funds available from central and local government for biodiversity enhancement works on-farm, these are typically contestable, are accompanied by particular requirements, and subject to the short-term of political cycles. As such, these funding incentives fall short of the systematic change required to fully recognise and balance the private-public share of costs and benefits (see for example, Brown and Stephens 2017).

Greater use of comprehensive policy-driven economic mechanisms such as taxes or levies will be required to incentivise conservation of indigenous biodiversity on-farm in recognition of the non-random distribution of indigenous biodiversity on private land, to even-out the current imbalance between 'cheap' development and 'expensive' conservation, and in recognition the benefits of enhanced biodiversity do not stop at the farm gate (see for e.g. Stephens et al. 2016; Tax Working Group 2019). An assessment of agri-environmental schemes implemented in other jurisdictions for the purposes of incentivising pro-biodiversity behaviours on-farm would be a useful exercise to determine potential adoption in New Zealand.

Such mechanisms can work in tandem with other policy initiatives such as education and outreach material, and provision of advice and could also address the geographical, land use, environmental history, and colonisation legacy drivers of inequity associated with biodiversity management responsibilities. Without such change-making levers, other policies are unlikely to successfully shift management practices at the scale and rate required to address the biodiversity and climate change crises.

Planning for indigenous biodiversity enhancement using farm planning

To illustrate how biodiversity considerations can be integrated into a farm plan by combining the concepts of ecological boundaries, natural capital and ecosystem services, we use a pastoral farm located near Tirau, in the Waikato Region, North Island, New Zealand (described by Dominati et al. 2019). The farm supports a 462 ha sheep and beef enterprise comprising rolling down lands, moderately steep to steep hill country, and flat to undulating terraces. The development of a farm plan identified critical sources of nutrient and sediment losses, and areas of the farm where productive capability was reduced. The typography of the farm along with management practices and the farmer's preferences provided the basis on which to divide the farm into land management units (defined areas of the farm with similar natural resources and under similar management practices), as typical of traditional land evaluation-focussed farm planning practice. In addition, analysis of the current condition of indigenous vegetation on-farm was undertaken and a restoration planting plan specifically to address on-farm goals was developed. By focussing on using indigenous species as a tool for reducing environmental risks on-farm; providing alternative income streams; and contributing to regional biodiversity conservation and wider resource management objectives; the restoration plan addresses on-farm goals that capture social, environmental, and economic values.

In this case study, we have focused on vegetation stocks, but note that the environmental plan (which would also include consideration of terrestrial and aquatic fauna as well as indigenous vegetation) is just one component of a comprehensive 'whole farm plan' which would also include considerations of the farm business, animal management, nutrient management, catchment goals, and the farmer's personal and family goals for the property (Maseyk et al. 2019). Critically, this would be a shift away from single-focus farm planning exercises such as farm plans targeted at addressing freshwater (e.g. riparian plans, nutrient management plans or a freshwater farm plan that will be required under the National Policy Statement for Freshwater). A whole farm plan could encompass these regulatory requirements but would extend beyond minimum obligations and the use of process as a compliance tool.

The development of a restoration plan specific to the farm enabled the exploration of options as to what species, where, for what purpose; as well as providing a detailed work plan. Using data from these plans, Figure 1 shows the key steps to integrate indigenous biodiversity into farm planning processes. The approach would be the same for capturing management decisions relating to aquatic biodiversity and fauna alongside native vegetation.

Managing expectations & tracking change

Restoring indigenous biodiversity on-farm will be a new management practice for many landowners. As such, they are unlikely to be familiar with key changes that would indicate the practice change is tracking in the right direction, at the expected rate, and towards achieving the identified performance measures. We suggest simple descriptors of the expected change in condition of biodiversity stocks (quality and quantity) are also identified within the work plan. Such descriptors can be used to not only answer 'what does success look like?', but also 'how do I know when I am there?'. For example, using our case study mānuka plantings, simple indicators of progress could include measures like 90% establishment success at year 1; 60–70 cm increase in height per year; and spread of 15–30 cm by year 1, 90 cm by year 2, and 2 m by year 4–5. Targets should be specific to soils, landform, aspect, and climate and may vary across different areas of the farm.

Monitoring performance

Performance reporting is critical for demonstrating change across time and space and the impact on profitability of the farm system. Performance reporting requires on-farm achievements to be measured against stated goals and defined thresholds of performance. This is long-established practice for benchmarking productivity (Beef+Lamb New Zealand 2020a; DairyNZ 2020) against regional average production (e.g. comparing on-farm food provision (kg/ha)), but additional metrics will be required to report against wider goals. This is not to suggest that monitoring should extend to measuring everything, everywhere. Rather, targets need to align with aspects of managing stocks and service provision that are in the control of the landowner through the conscious implementation of specific land management practices. In particular, it will be critical to align measures of ecosystem service provision with both measurement of stock condition and the contribution of stocks to socio-economic benefits (Maseyk et al. 2018; Matzek 2018). For example, indicators can inform on ecosystem properties (e.g. in-

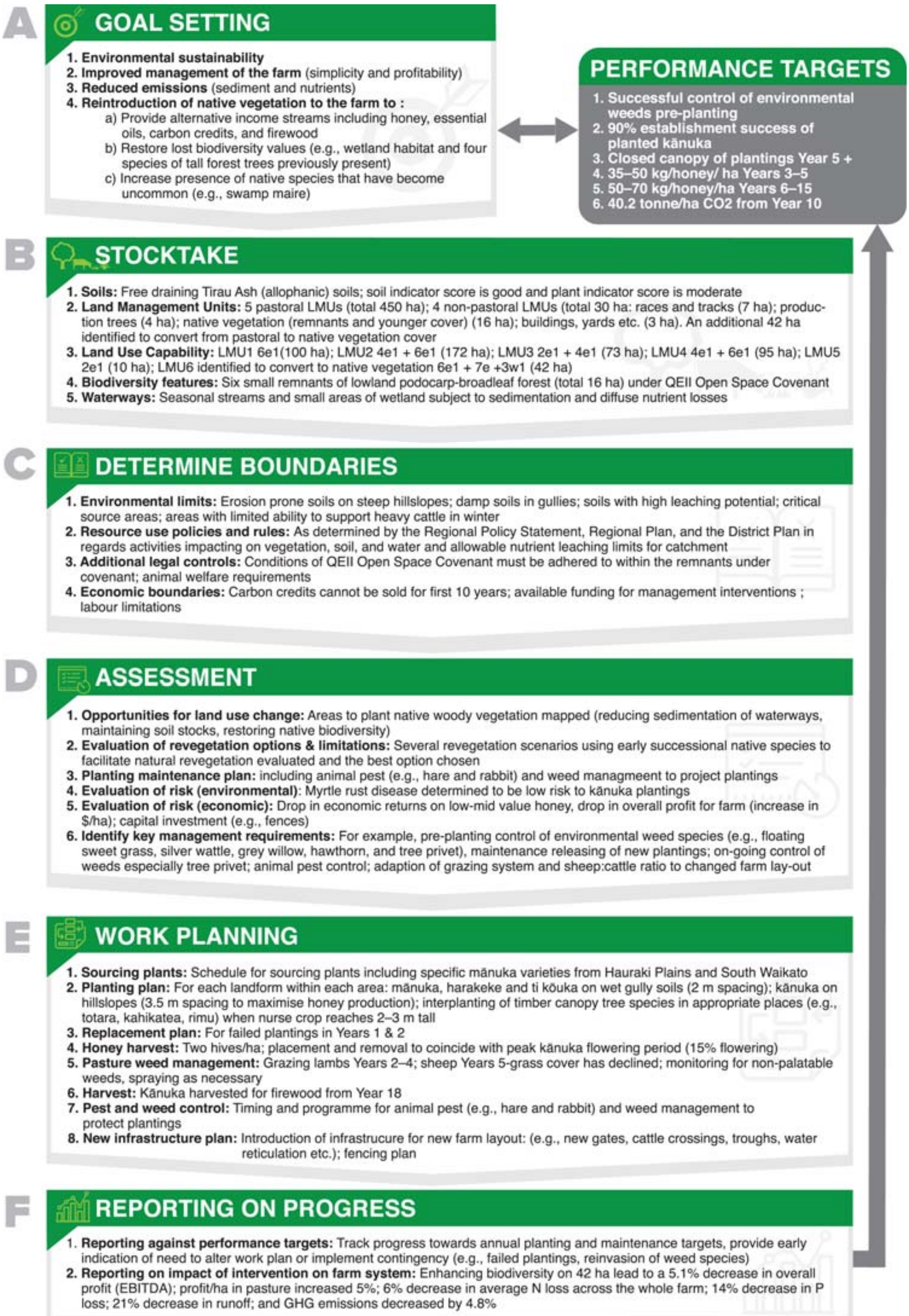

Figure 1. Simplified illustrative example of integrating indigenous biodiversity into the key components of farm planning processes (following Maseyk et al. 2019) based on the sheep and beef farm case study. Goals and performance targets would sit alongside other goals for the farm (e.g. productivity and profitability, and social goals and targets). Data sourced from Singers and Bayler (2017) and Dominati et al. (2019).

stream physio-chemical or biotic measures); ecosystem functions (e.g. nutrient attenuation, measured as kg N/ha/yr); ecosystem services (e.g. food provision, measured as kg meat/ha), or a proxy ecosystem service indicator (e.g. amenity values as indicator of wellbeing and social benefits).

Dominati et al. (2019) used the same case study farm presented here to demonstrate how biodiversity restoration coupled with farm system optimisation can deliver multiple benefits ranging from increased per hectare profitability to decreased environmental footprints (see Reporting on progress box, Figure 1). Although we will have limited ability to demonstrate the real impacts of practices such as biodiversity restoration until farm scale tools are able to model ecosystem service supply from both pastoral and non-pastoral parts of the farm; optimisation modelling exercises like the one applied by Dominati et al. (2019) already provide a good indication of the direction of change.

We also envisage that, with time, an increase in data will enable increased confidence in indirect measures (such as key indicators and proxies) to anticipate ultimate outcomes based on defined characteristics. For example, as restoration trajectories are better understood; greater confidence can be placed in assumptions based on a certain intervention or management practice in terms of tracking towards a specified target, as is the case with soil conservation (e.g. 100 poles planted per hectare to prevent slips). This further emphasises both the need for and value of sustained monitoring.

Capacity and resourcing

This shift in approach to farm planning will require increased sector capacity and knowledge, particularly to fully understand the interplay between farm system management, ecological theory, and conservation and restoration techniques. There is obvious value in utilising experts and we do not suggest an expectation should be placed on individual farmers to themselves develop a fully integrated farm plan. We note that engaging with relevant experts on matters critical to the farm business is normal practice (e.g. farm planning consultants, fertiliser representatives, nutrient budget consultants, bank managers and accountants, council-funded regulatory advisors, veterinarians, wool brokers). However, recognising the need for the involvement of key experts should not occur at the cost of farmer buy-in or ownership of the farm planning process. It is therefore critical that subject experts and farm consultants work alongside the farming family to avoid farm planning becoming something that 'happens to' farmers rather than being a farmer-driven, integral part of their business.

Our case study serves to illustrate that even with incomplete knowledge initial steps to integrate biodiversity into farm planning can be taken now. With time, initial goals can be further developed, and the necessary management actions captured within subsequent work plans. We also highlight that integrating biodiversity into farm planning is an ambitious endeavour and will require the input of relevant experts and additional resourcing.

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