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Research

Resilient and sustainable natural resource production: how are farmers and foresters coping?

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ABSTRACT. Adapting to the anthropogenic environmental change while transitioning to a more sustainable and more productive natural resource management places unprecedented demands on natural resource production. Meeting this complex challenge without unwarranted environmental degradation or loss of livelihoods requires understanding and managing the resilience of properties that produce natural resources. However, insufficient attention has been paid in research and natural resource governance to the capacity of natural resource producers to adapt and achieve sustainable outcomes at the property-level, potentially leading to unintended environmental and social outcomes. We used a large and detailed survey data of farmers, foresters, and growers in New Zealand to identify factors that correlate with property-level outcomes that are desirable from the perspective of sustainable natural resource production: strong environmental performance, good financial situation, and high well-being. The results detail how these outcomes correlate with diverse individual traits and outlooks, property-level agroecosystem characteristics, economic resources, and social interactions. However, different factors drive individual outcomes, and a factor that is positively correlated with one desirable outcome may negatively correlate with another. The only factor that positively correlated with all three outcomes was the goal to have strong environmental performance in future, which may reflect optimism as a resilience determinant. Thus, the difficulty of achieving good outcomes across all three dimensions may arise from conflicting effects of different factors on property-level environmental, economic, and well-being outcomes. In conclusion, our results indicate that natural resource governance must more carefully consider interdependencies between environmental, financial, and well-being outcomes at the property-level to support the ability of natural resource producers to meet society's demands.

Key Words: *agriculture; forestry; New Zealand; resilience; sustainable natural resource production*

INTRODUCTION

The urgent need to restore Earth's natural environment (Díaz et al. 2019) coincides with the accelerating use of natural resources. The total annual global consumption of natural resources is expected to more than double from 2017 levels by 2060 because of growing human population and rising affluence (FAO 2022). Meeting humanity's need for natural resources while concurrently restoring ecosystems requires a major transition toward more sustainable natural resource production. To be sustainable, natural resource management should not only protect non-human nature but also support human well-being and cultivate economic opportunities (Thiele 2016). The United Nations 2030 Agenda for Sustainable Development states that all sectors, including natural resource production, must consider the three dimensions of sustainability, i.e., economic, social, and environmental: "If the soil was bad, or if water was not managed well, then a farm might have been considered unsustainable. (...) If a farm is not economically sound or not resilient to external shocks, or if the well-being of those working on a farm is not considered, then a farm cannot be sustainable." (SDG Indicator 2.4.1; FAO 2023).

However, insufficient attention has been paid in scientific literature and environmental governance to the diverse impacts that the implementation of top-down environmental targets and shifts to more environmentally friendly practices may cause to the well-being and livelihoods of natural resource producers (Plagányi et al. 2013, Bennett et al. 2019, Woods et al. 2021, Meyfroidt et al. 2022, McDermott et al. 2023). For example, in the past 30 years, millions of jobs in food production have been lost and the trend is predicted to continue (Brondizio et al. 2023). In many countries, the falling farmgate prices coinciding with increasing living expenses and input prices (the "cost-price squeeze") has led to more concentrated natural resource production in the hands of fewer producers (Short et al. 2021, Stats NZ Tatauranga Aotearoa 2021, Schuch et al. 2022). Another example is provided by those target-based environmental policies that have contributed to a loss of local people's access to natural resources (McDermott et al. 2023). Natural resource producers' decreased well-being or unintended, unsupported, and/or involuntary transition to other livelihoods conflicts with the goal of sustainability (including the principle of equity) and may undermine the long-term success of ecosystem restoration (Bennett et al. 2019, Yletyinen et al. 2022). Thus, achieving more sustainable natural resource production requires also estimating property-level outcomes from environmental, economic, and social well-being dimensions and understanding how these three "pillars" of sustainability can be enhanced at the property-level.

A significant challenge in achieving and maintaining balance in environmental, social, and economic welfare in natural resource production is the dynamic nature of sustainability. Because the world is ever-changing, sustainability requires constant learning and adaptation (Thiele 2016). Hence, understanding resilience is vital to the progress toward sustainability (Marchese et al. 2018). It describes the capacity of natural resource production to adapt and persist in the face of change or make intentional changes that guide natural resource production into a more sustainable pathway when needed (Folke 2016, Marchese et al. 2018, Walker 2020). Critically, there are limitations to how many changes can take place at a property before the entire property or wider natural resource production system starts to change (Scheffer et al. 2012).

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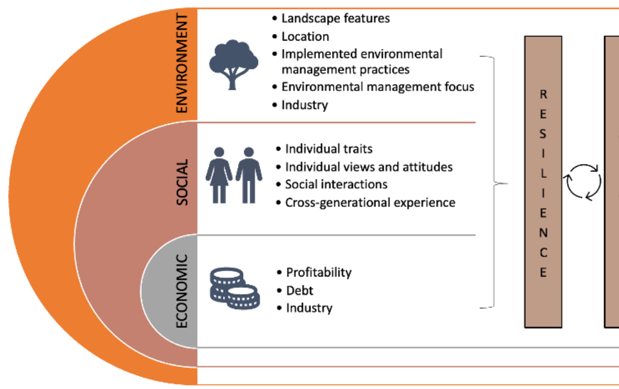
In this study, we shift the emphasis in studying natural resource production from the usual national- or international-level production and environmental targets (e.g., Tittensor et al. 2014, Díaz et al. 2019, Prime Minister's Office 2020, Hinrich Foundation 2022) to property-level sustainability and resilience. Specifically, we investigate the ability of natural resource producers to achieve positive environmental, economic, and well-being outcomes at the property level, and identify factors that may underlie their resilience to do so. Natural resource production properties (e.g., farms, forestry properties) are the key site of action for sustainability and resilience in natural resource management (Darnhofer et al. 2010, Short et al. 2021). It is ultimately the property owner or manager who navigates the shifts in societal and environmental conditions, based on his/her perception of the potential, risks, and limits of each situation and the availability of resilience-enhancing resources (Darnhofer et al. 2010). Moreover, the impacts of environmental changes, as well as many new sustainability-seeking policies, directly impact natural resource production properties (FAO 2021, 2022, Blattert et al. 2023).

Resilience of a property, in turn, is an emergent trait and a process (Folke 2016). Properties for natural resource production are complex adaptive social-ecological systems in which the social and economic dimensions are embedded in the natural environment (Yletyinen et al. 2019). A property's resilience (and eventually property-level sustainability) emerges from the complex interplay between intertwined environmental, social, and economic factors that enable the property to adapt to change (Folke et al. 2016, Yletyinen et al. 2019; Fig. 1), such as help from neighbors or material well-being. The Food and Agriculture Organization of the United Nations, for instance, considers adaptive capacity, assets, social networks, and access to basic services as determinants of the resilience of agricultural households (d'Errico et al. 2021). Furthermore, people whose livelihoods depend on natural resources may demonstrate a high capacity to cope with changes in economic conditions and maintain production (e.g., through further intensification of production practices), but potentially at the expense of environmental or social well-being, or vice versa. Natural resource systems are characterized by strong environment–economy–well-being interdependencies (Yletyinen et al. 2019).

Because of such complex interdependencies and trade-offs, an inadequate understanding of the resilience and sustainability of natural resource producers and their livelihoods at higher levels of natural resource management and decision making may underlie unintended negative social outcomes in the natural resource management (Plagányi et al. 2013, Short et al. 2021, Woods et al. 2021, McDermott et al. 2023). Framing the property holistically as a social-ecological system and thereby estimating which property-level factors may underlie positive environmental, social, and economic property-level outcomes can therefore open new perspectives on building resilient and sustainable natural resource production (Darnhofer et al. 2010). Furthermore, because resilience and sustainability assessments are typically built on external evaluations aiming for objective assessment of resilience, they may fail to capture the perceptions of individuals whom these assessments ultimately concern (Jones 2019). Yet, understanding the emergent nature of resilience and sustainability requires keen attention on the perceptions,

Fig. 1. Farms and forest properties are social-ecological systems comprising interacting environmental, social, and economic facets. The resilience of a property emerges from different context-specific environmental, social, and economic factors and processes (examples of such resilience determinants are presented in the bullet point lists). As resilience enables the property owner/manager to persist in the face of change and learn, it also influences which factors the property owner/manager will invest in in the future. A property's resilience, in turn, determines its ability to face the changes required for shifting to more sustainable natural resource production, and remaining in a sustainable state while adapting to other societal and environmental changes and needs. Sustainability can be both a society's requirement for natural resource production and a trait of a property.



judgments, and capabilities of individuals whose actions constitute the overall resilience and sustainability of social-ecological systems (e.g., Yletyinen et al. 2021a). Finally, relying on national-level measures for sustainability and resilience poses a significant risk of failing to notice in time property-level performance that may erode future resilience (Sundstrom et al. 2022).

An intriguing case for studying property-level outcomes in the primary industry is Aotearoa New Zealand (NZ), where the primary sector is a significant driver of the economy, rural well-being, and land use change (Cradock-Henry et al. 2019). Approximately half of NZ's total land area is used for agriculture and forestry, and the food and fiber sector employs 13% of NZ's total workforce (Ministry for the Environment & Stats NZ 2021, Ministry for Primary Industries 2022a). Tree plantations supply all of NZ's industrial wood (Forest Owners Association 2022). In the 1980s, NZ's primary production shifted from the goal of maximizing production with practices such as high use of fertilizers, to the goal of running a profitable business with succession opportunities (Knook et al. 2023). Subsidies were removed from agriculture in the 1980s (Saunders 2019). At present, NZ's primary industry is increasingly focused on building resilient natural resource systems of production with more multifaceted goals, including environmental, financial, and well-being considerations (Knook et al. 2023, Ministry for Primary Industries 2020, 2022b). Since 2002, both the land area used for primary production and the number and size of farms have decreased (Ministry for the Environment & Stats NZ 2021).

NZ farmers, growers, and foresters have faced diverse environmental and societal changes and shocks, including severe earthquakes and some negative public perceptions of entire primary production sectors, e.g., the "dirty dairying" public campaign highlighted the negative environmental impacts of dairy farming (Ministry for Primary Industries 2017, Tall and Campbell 2018). Still, despite the recent rising input costs for natural resource producers, adverse weather events, and a difficult labor market during the COVID-19 pandemic, NZ's agriculture and forestry sectors have continued to produce food and fiber for domestic and international markets (Ministry for Primary Industries 2022a). In 2021–2022, NZ's food and fiber sectors even broke a new export revenue record, partly due to sharp increases in prices (Ministry for Primary Industries 2022a). Such an overall level of export performance during turbulent times has been suggested to be a demonstration of NZ's primary industries' resilience (Ministry for Primary Industries 2022a). Moreover, in 2022, NZ reached the top position of the Hinrich-IMD Sustainable Trade Index, which measures the readiness and capacity of 30 major trading economies to sustainable trade with 70 indicators that cover the three pillars of sustainability (Hinrich Foundation 2022). Yet, questions have been raised for years about the sustainability and long-term resilience of NZ's natural resource production because of, for example, negative environmental impacts of land use intensification, farmers' occupational stress, and limited rights of Indigenous Peoples (Brockerhoff et al. 2001, Ewers et al. 2006, Firth et al. 2007, Fitzharris 2007, Mackay 2008, Moller et al. 2008, Kenny 2011, Bataille et al. 2021, Ministry for the Environment & Stats NZ 2021, 2023, Etherington et al. 2022, Joy 2022, McClone et al. 2022, Renwick et al. 2022). The public has also expressed increasing concern for increasing foreign ownership of NZ primary production, which the public associates with the intensification of land use and negative impacts on the environment (Ministry for Primary Industries 2017).

In this study, we utilize a large survey dataset to investigate the property-level outcomes in NZ agriculture and forestry, including several natural resource production sectors, and identify factors that may underlie property-level positive environmental, financial, and social outcomes. We first ask how NZ farmers, foresters, and growers (i.e., producers who grow kiwifruit, wine grapes, flowers, seed crops, etc.) conceive of their environmental performance, financial situation, and personal well-being (the three pillars of sustainability). In the context of this study, we define positive property-level outcomes as strong or very strong environmental performance, a good or very good financial situation, and high individual well-being to include the three pillars of sustainability (e.g., Beachy 2010). The focus on good or very good outcomes is based on the notion that well-performing producers are most likely to remain on a desirable development pathway (such as sustainable natural resource production) despite evolving regulatory pressures, social expectations, and global environmental change, whether due to ecosystem resilience built by pro-environmental practices (Kremen and Merenlender 2018) or availability of economic resources that increase response capacity during crises (Walker 2019a, 2019b).

We then explore which factors may explain the ability of some NZ farmers, growers, and foresters to adapt to societal and ecological change and achieve positive outcomes. Prior research has shown that certain characteristics of natural resource producers and their operations can explain specific property-level outcomes such as resilience, although context-dependent variation in the significance of such characteristics is common (Knowler and Bradshaw 2007, Biggs et al. 2015, Kuhmonen 2020, Cradock-Henry 2021). Because all NZ farmers, foresters, and growers are embedded in the same national and global governance structures and systems of production and consumption, the ability of some to persist and thrive in primary production mainly emerges from individual or property-level traits and resources that enable adaptation and moving forward (Walker 2019a, Kuhmonen 2020, Cradock-Henry 2021). Although we here focus on individual and property-level factors, we recognize that property-level resilience emerges from many types of factors and processes within the wider social-ecological systems in which the resource producers are embedded (Gunderson and Holling 2004, Walker 2020). To answer this research question, we undertake regression analyses with a rich variety of individual- and property-level independent variables (Table 1) to identify factors associated with strong property-level environmental performance, a good financial situation, and individual well-being, one outcome at a time. The quality of each outcome is evaluated by the properties' decision makers who are responsible for most long-term planning (Stahlmann-Brown 2021).

Finally, we focus only on those NZ farmers, foresters, and growers who have achieved positive outcomes in all three aspects, i.e., they perceive their environmental performance, financial situation, and well-being as being good or very good. Resilience research has shown that people whose livelihoods depend directly on natural resource production are better able to adapt to changing conditions when they are both environmentally sustainable and profitable; prioritizing economic, environmental, or well-being aspects to the exclusion of the others erodes property-level resilience (Plagányi et al. 2013, Darnhofer et al. 2016, Yletyinen et al. 2019). Detecting significant predictors that differ from the outcome-specific regression models may signal factors that explain the ability of these "triple bottom line" farmers, foresters, and growers to successfully mitigate potential trade-offs between environmental, financial, and well-being outcomes (Plagányi et al. 2013, Deng et al. 2016).

The agricultural and forestry sectors are immensely diverse and different sectors and properties will pursue different paths to remain in operation and meet the sustainability goals (Beachy 2010). This study strives to untangle the complex nature of sustainable and resilient resource production by exploring simultaneously environmental, financial, and well-being outcomes across multiple land-based natural resource sectors, and by investigating the possibility that different factors may underlie these three outcomes. In so doing, the study investigates the general resilience of NZ natural resource production properties from the perspective of the property owner/manager's ability to navigate change and achieve positive outcome in his or her social-ecological setting. Identifying factors that support the natural resource producers to cope with change and gain positive outcomes contributes to maintaining diversity in resource production strategies and knowledge and, in so doing, to building resilient and sustainable natural resource systems (Plagányi et al. 2013, Biggs et al. 2015, Short et al. 2021, McDermott et al. 2023).

Table 1. The variables included in the study as potential factors underlying resilience and good or very good outcomes in environmental, financial, and well-being dimensions. The left-hand column includes general description of the factors both as determinants of resilience and as significant variables in the results of this study.

General description	Variables in regression models
Individual traits and views:	
Together with subjective well-being, individual traits, views and attitudes are important components of resilience; they enable and motivate producers to act (Chaigneau et al. 2022). These factors capture the personal background against which a producer makes decisions (Schill et al. 2019, Kuhmonen 2020). Many of the individual-level factors reflect learning and accumulation of practical experience, skills, and abilities, which directly influence decision making (e.g., Knowler and Bradshaw 2007, Gifford and Nilsson 2014, Price and Leviston 2014, Bowditch et al. 2019, Teff-Seker et al. 2022). Frequent exhaustion has detrimental effects on one's well-being and ability to gain a livelihood. Environmental performance was in this study the only positive outcome that did not significantly correlate with emotional exhaustion. The relationship between individual well-being and pro-environmental behaviors is complicated and may depend on motivation, e.g., whether the behaviors are voluntary or resulting from outside pressure (Venhoeven et al. 2013). A possible explanation for the gap between climate change beliefs and strong environmental performance in our results may be psychological distance to climate change and consequently perceived low individual or collective ability to mitigate climate change, in comparison to reducing soil erosion or increasing native biodiversity at a property (Haden et al. 2012, Price and Leviston 2014). In addition, environmental behaviors may result from other motivations, e.g., saving money (Homburg and Stolberg 2006) or place-attachment (Takahashi and Selfa 2015), which, in turn, can result from place-specific on-farm experience. Thus, strong environmental performance per se does not require believing in climate change.	Age, Level of education, Years of on-farm experience, How many generations have been involved in agriculture or forestry, Personal willingness to experiment, Frequency of experiencing physical exhaustion, Frequency of experiencing emotional exhaustion, Personal view: strength of environmental performance of own operation in 10 years' time, Personal view: it is important that the public sees farmers, foresters, and growers doing their part for the environment, Personal view: climate change is real.
Characteristics of the farm, forest, or growing operation, environmental management focus, implemented environmental management practices:	
The agroecosystem setting provides a structural basis for rural production (Fischer 2018, Cradock-Henry 2021) and assets for adaptation and transformation. These factors can enhance or constrain property-level resilience for example, through landscape features, the ability to change crops, harvest/logging locations, or have forest patches at different development stages (Cumming et al. 2017, Bennett et al. 2021). The agroecosystem characteristics of the property influence, and are influenced by, the producer's environmental management practices and financial situation (Fischer 2018, Cradock-Henry 2021). For example, larger property areas can contribute to strong environmental performance by providing opportunities for conservation, by maintaining the spatial resilience of the property (e.g., higher diversity of ecological processes across scales [Cumming et al. 2017, Kremen and Merenlender 2018]), and by providing material assets for buffering change. Some industries, such as forestry, can provide a favorable agroecosystem setting for managing biodiversity and soil erosion (Kremen and Merenlender 2018); planted forests provide habitat for numerous threatened native species (Pawson et al. 2010, Suryaningrum et al. 2022) and can reduce erosion (Soto-Navarro et al. 2020). In our results, strong environmental performance was not associated with specific landscape features. We found negative correlation between a good financial situation and having land unsuitable for production, which likely indicates decreased efficiency of operations. The finding could also signal innovative ways of land use in terms of utilizing the land on property. The negative correlation in our results detected between specific industries and high well-being, i.e., sheep and beef, dairying, and horticulture, may reflect industry-related work load and regulations (Firth et al. 2007, Mishra et al. 2012). Dairy farming, for instance, is characterized by long work hours and high burn-out rates (Botha and White 2013). Similarly, the negative association of larger properties with well-being may indicate the effects of greater work load and potentially higher number of staff required by larger properties (Botha and White 2013, Plogmann et al. 2022). The good or very good financial situation was the only outcome that significantly correlated with the property's geographic location. The regions with positive correlations are distributed across NZ, suggesting that financial outcome is not caused by specific climatic conditions (cf. NZ climate zones [NIWA Taihoro Nugurangi 2001]). The finding could suggest otherwise favorable areas for production, varying levels of support provided by local governments, and/or individuals with ability to relocate.	Area of the property, Waterways present on property, Minor ways and drains present on property, Native bush on property, Busy roads on property, Wetlands on property, Land not used for production on property, Primary industry of the property: Sheep and beef / Dairying / Arable farming / Horticulture / Forestry, Location (15 regions), Environmental management focus of the property: Reducing greenhouse gas emissions / Increasing native biodiversity / Improving health of waterways / Reducing soil erosion / Managing biosecurity, Implemented environmental management practices on the property: Reducing soil erosion / Increasing plant diversity.
Economic resources:	
Economic resources reflect material well-being, which increases the ability of the producers to adapt to changes and shocks or to transform to new ways of doing things, e.g., through major buffering impact supporting survival, providing purchasing power for investments, and development of the operation (Greig et al. 2019, Chaigneau et al. 2022). Debt financing is an important strategy in natural resource production because it provides flexibility and enables investing (Greig et al. 2019). In the longer term, debt may erode resilience especially during the times of lower productivity (Greig et al. 2019). Although farm profit levels are not high in NZ relative to the investment, prior research suggests it does not decrease farm resilience (Greig et al. 2019). In agreement with our results, a majority of NZ farms have been found to be financially strong (Greig et al. 2019). Our study detected significant positive correlations between profitability and high well-being, suggesting that low profitability can erode property-level resilience through individual well-being, in line with the study by Klerxk et al. (2010). Economic difficulties are one of the leading causes of stress among NZ farmers (Firth et al. 2007), and may lower the beliefs in, or ambitions to, future environmental performance.	Profitability of the operation in the past two years, Total debt in relation to the total value of the operation

(con'd)

Social interactions: Interacting with groups of actors with diverse interests contributes to gaining different types of knowledge, potentially influencing own behaviors and views (Bodin and Prell 2011, Yletyinen et al. 2021b). Strong social connections are widely known to provide psychological well-being (Walker 2019a), also among NZ farmers (Firth et al. 2007). Being connected to the “right” people or groups for advice, new knowledge, and resource sharing can positively contribute to resilience (Amel et al. 2017, Niemiec et al. 2019, Grilli and Curtis 2021, Yletyinen et al. 2021b). That said, not all social connections enhance resilience (Bodin 2017, Yletyinen et al. 2021b). They may also weaken resilience via poor advice or by replacing more helpful social interactions (Biggs et al. 2015). Our analysis detected positive correlation between well-being and identifying peers and peer support groups as the most helpful source of advice. Multiple benefits of peer-to-peer communication have been identified in prior research, including comfortable exchange of ideas and knowledge, relationship-building, and collaboration (e.g., Kueper et al. 2013). All such benefits are also well-established resilience determinants in environmental governance (Bodin and Prell 2011). Only one social group (specifically, accountants, bankers, insurers) was significantly and negatively associated with strong environmental performance in our results. It may indicate an absence or heterogeneity of helpful social groups that interact with NZ producers to promote and guide strong environmental performance.	Most helpful source of advice: Industry or levy bodies, industry companies and industry events, suppliers, business services, and sales advisors / Ministry of Primary Industries, other ministries, council, scientists, scientific publications / Peers and peer support groups / Veterinarians and consultants / Media: books, tv, newspapers, trade magazines, online forums, blogs and social media / Accountants, banks, insurers

METHODS

Survey data

The Survey of Rural Decision Makers is a national-scale, repeated cross-section online survey of the primary sector conducted biennially since 2013. The questionnaire covers topics ranging from ownership structure, property classification, land use and land-use change, management regimes, future expectations, forestry and greenhouse gas emissions, to personal values, expectations regarding future climate, trusted sources of information, and demographics. Critically for our purposes, the 2021 wave of the survey also included modules covering perceived environmental performance, financial performance, and well-being (Stahlmann-Brown 2021).

More than 6700 farmers, foresters, growers, and “lifestyle block owners” (broadly speaking, people who do not depend on their rural properties for their livelihoods) completed the 2021 wave of the survey. We focus on the respondents who identify as being commercial operators. The survey data on commercial operators covers over 5% of the approximately 50,000 commercial farms, forests, and growing operations in NZ. The data is broadly reflective of primary industry in NZ, although dairy and sheep and beef farmers are intentionally oversampled. The data also reflects the demographic composition of NZ’s primary sector (Stahlmann-Brown 2021).

The 2021 questionnaire included nearly 600 potential data points for each respondent, although branching and question randomization meant that no respondent saw every question. In total 2496 survey respondents from commercial farms, forests, and growing operations answered specific questions about perceived environmental performance, financial situation, and personal well-being. Thus, we used the sample of 2496 respondents to answer the first research question. A subset of the 2496 survey respondents’ data was then used in the regression analysis because it was based on a much larger number of survey questions. Regression results reported below are for the 1672 commercial respondents’ subset who were presented with and who responded to all of the questions of interest.

The study design was reviewed for social ethics at Manaaki Whenua - Landcare Research under the guidelines of the Code of Ethics developed by the New Zealand Association of Social Science Researchers. This Code of Ethics emphasizes informed consent, freedom from coercion to participate, individual privacy, confidentiality, and sensitivity to participants’ circumstances. The survey included a statement of informed consent. It specified that participation is optional, that the respondents can stop answering the survey at any time, and that all responses are treated confidentially.

Regression analysis

We used binary logistic regression to identify individual- and property-level factors that correlate with the ability of NZ farmers, foresters, and growers to achieve strong environmental performance, a good financial situation, or/and high well-being. The independent variables included a rich variety of factors describing property-level agroecosystem features, environmental management and financial situation, land-owner/manager’s personal traits and social networks (Table 1, Appendix 1 Table S1). The probability of the outcome was predicted given known values of explanatory variables, which may be continuous or categorical. Specifically, we estimated:

$$P(Y) = \frac{1}{1 + e^{-(b_0 + b_1 X_{1i} + b_2 X_{2i} + \ldots b_n X_{ni})}} \qquad (1)$$

in which Y is the dependent variable, b_0 is the intercept of Y, and b_n is the regression coefficient of the corresponding independent variable X. We used the forced entry method, in which all explanatory variables are included in the model simultaneously. Odds ratios, which measure the ratio of the odds that a farmer, forester, or grower belongs to the outcome category given the presence of an explanatory variable compared to the odds of it occurring in the absence of the explanatory variable, are reported. Odd ratios greater than 1 indicate that as the explanatory variable increases, the odds of the outcome occurring increase, and vice versa.

Dependent variables

Four regression analyses were undertaken. The first three used survey respondents’ perceptions of their properties’ environmental performance, their financial situation, and their well-being as dependent variables. In the fourth model, the dependent variable indicated respondents’ perception of having achieved all three desirable outcomes, i.e., strong environmental performance, financial situation, and well-being (hereafter, the “triple outcome”). Although the connection between producers’ subjective perceptions of their performance and the external, indicator-based measurements of performance is complicated (Kuhmonen 2020), for the purpose of our study, perceptions on outcomes provided holistic evidence on the performance of the property from the farmer, forester, or grower's perspective. Importantly, they reflected the resource producer's understanding on the resilience of the property (Berkes and Ross 2013, Kuhmonen 2020).

The binary dependent variables are defined as follows. First, to evaluate environmental performance, we analyzed response to the statement "The environmental performance of my operation over the last 12 months was ..." Specifically, we categorized respondents who replied "strong" or "extremely strong" (as opposed to "extremely weak," "weak," "slightly weak," "neither weak nor strong," "slightly strong") as practicing behaviors and production techniques that maintain or restore ecosystem health. We acknowledge that the measure assumes a common reporting function, i.e., we assume that two different respondents with identical performance would complete the statement identically. However, self-reported measures of environmental performance have been shown to correlate with empirical measures of environmental performance (Pérez Urdiales et al. 2016), suggesting that environmental performance is well-understood among farmers, growers, and foresters. Moreover, NZ farmers, growers, and foresters are subject to strenuous environmental regulation that provides them direct evidence of their performance. For example, the NZ government has started to require freshwater farm plans for all properties with more than five hectares in horticultural use and more than 20 ha in arable, pastoral, or combined use; these plans are subject to both certification and audit against data collected by the regulator. As such, we contend that environmental perceptions are based on the producer's expert knowledge and experience-based understanding of environmental processes at the property, and thus constitute an integral part of the capacities contributing to the resilience of the production system (Kuhmonen 2020).

A property's overall financial situation indicates the ability of the producer to achieve a good livelihood from natural resource production. The survey respondents had answered the question "How do you assess the overall financial situation of the farm, forest, or growing operation?" with answer options "very good," "good," "neither good nor bad," "bad," "very bad," "unsure," or "prefer not to answer." We identified those with answer options "good" or "very good" as survey respondents with the desirable financial outcome.

Well-being frameworks are increasingly used in natural resource resilience and sustainability research (Chaigneau et al. 2022, Chaigneau and Schill 2022) and high stress levels have become a significant concern in many rural communities (Firth et al. 2007, Kallioniemi et al. 2016, Naik 2017). For estimating survey respondents' level of well-being, we used the World Health Organization's Five Well-being Index (WHO-5). Brown et al. (2021) recommend subjective well-being measures as part of a sustainability indicators framework. The WHO-5 is the most common measure of current subjective mental well-being used worldwide (Topp et al. 2015). It is based on five survey questions in which respondents estimate how often, over the past two weeks, she/he (1) has felt cheerful and in good spirits, (2) has felt calm and relaxed, (3) has felt active and vigorous, (4) woke up feeling fresh and rested, and (5) daily life has been filled with things that interest me, each with answer options: "all of the time," "most of the time," "more than half the time," "less than half the time," "some of the time," or "at no time" (Mental Health Services [date unknown]). The maximum score for each question that the responder can get is five, from the answer option "all of the time," whereas the consequent answer options give the scores of four to zero. Thus, the maximum WHO-5 score is 25. A cumulative score below 13 is commonly identified as poor well-being, whereas a result of 25 indicates the best possible well-being and zero the worst imaginable well-being (Topp et al. 2015). For example, Stats NZ Tarauranga Aotearoa, which is NZ's official data agency, uses the threshold of 13 for poor well-being. There is no agreed upon WHO-5 threshold indicating sufficiently high well-being. In this study, we interpreted the respondents with WHO-5 scores of 17 or over to have high well-being. In line with the two other dependent variables, we strived to capture good well-being and not slightly good or neither good nor bad well-being, which values closer to 13 might have indicated. The WHO-5 is commonly translated to percentage scale by multiplying the raw score four, in which score zero represents the worst imaginable well-being and 100% the best imaginable well-being (Topp et al. 2015). The WHO-5 score of 17 translates to circa 70%, indicating above average well-being. Our results on factors associated with well-being are largely unchanged when we vary the cut-off between WHO-5 scores 15 and 20.

While the WHO-5 is subject to common reporting function, it has been validated in several dozen countries in Africa, Asia, Europe, The Americas, the Middle East, and Oceania (Topp et al. 2015). Moreover, measured well-being is consistent and intuitive: for example, victims of torture report low well-being, on average; people in high-income countries report high well-being, on average; and people living with chronic disease report lower well-being than the general population (Topp et al. 2015). Technically, the triple outcome producers are those who had responded "good / strong" or "very good / strong" to both the environmental performance and financial situation questions as described above, and additionally gained a WHO-5 score of 17 or higher.

Regression analysis is normally predicted on the basis that the dependent variable is cardinal rather than ordinal. However, our data are ordered and categorical. Some researchers (Ferrer-i-Carbonell and Frijters 2004) have advocated the use of ordered logit estimation for ordered categorical data, but Bond and Laing (2019) show that even ordered logit estimation imposes assumptions on the distribution. Thus, we follow the approach advocated by Bloem and Oswald (2022), which is to split the sample into "high" and "low" categories, (e.g., "good or very good financial situation" and "other financial situation") on the dependent variable.

Each of our binary logistic regressions imposes no distributional assumption on the data other than ordering. Our "triple outcome" regression is also binary logistic, measuring whether the respondent concurrently achieves the "high" outcome in financial performance, environmental performance, and well-being.

Independent variables

From the perspective of resilience-based natural resource management, a property for natural resource production is a unit consisting of its owner or manager with personal mental models, preferences, abilities, etc. that provide for adaptation social and cultural capital, and a biogeophysical component including land, crop, buildings, and other resource ecosystem properties that provide natural and economic capital (Darnhofer et al. 2016, van der Lee et al. 2022). Hence, similar to Kuhmonen's recent study (2020), we selected a wide variety of explanatory variables that reflect a producer's individual agency (e.g., farm experience) and the structure of operation (e.g., area of the property; right-hand side column in Table 1, for detailed definitions see Appendix 1 Table S1). We include explanatory variables that describe individual traits, economic status of the property, the agroecosystem setting, including landscape features, and the property owner's/manager's social interactions in terms of who the farmers, growers, and foresters consider the most trusted sources of advice and information. Although the selection of variables was data-driven, it was guided by research on resilience determinants, as summarized in Table 1.

RESULTS

Positive property-level outcomes among NZ farmers, foresters, and growers

The survey data suggests that despite turbulent times, most NZ farmers, foresters, and growers estimated their financial situation and/or environmental performance as good or very good in 2021 (Figs. 2 and 3). Specifically, over half of the 2496 respondents who had answered questions about the outcomes estimated their environmental performance as strong or very strong (n = 1362, 54%). Note that the number of responders is larger here than in the regression analyses because the regression analysis was limited to the responders who had been presented and had answered all the questions included in the models. Similarly, 60% of the respondents estimated their financial situation to be good or very good (n = 1487). Half of the respondents (n = 1292, 52%) reported a WHO-5 score of 17 or over, indicating good well-being (Fig. 4). Further, our results suggest that approximately one-fifth of the NZ farmers, foresters, and growers in our dataset of 2496 respondents had achieved the combination of strong environmental performance, good financial situation, and good well-being (523 respondents, 21%).

Fig. 2. Survey respondents' perceptions of the environmental performance on their farm, forest, or growing operation (n = 2496). A large majority of the respondents considered their environmental performance as slightly strong, strong, or extremely strong.

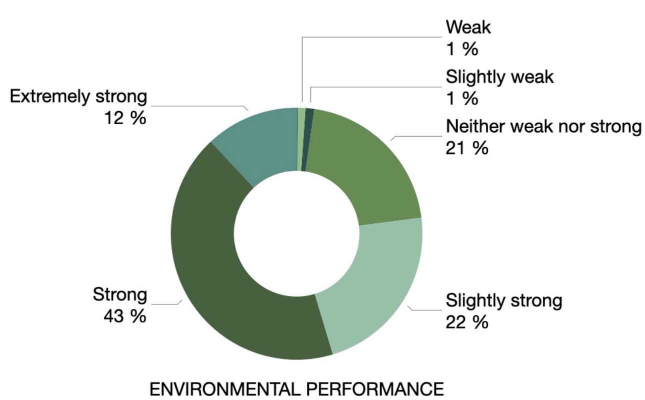


Fig. 3. Survey respondents' perceptions of the financial situation of their operation (n = 2496). Most respondents reported their financial situation as being good or very good. A small minority of the respondents estimated their financial situation as bad or very bad.

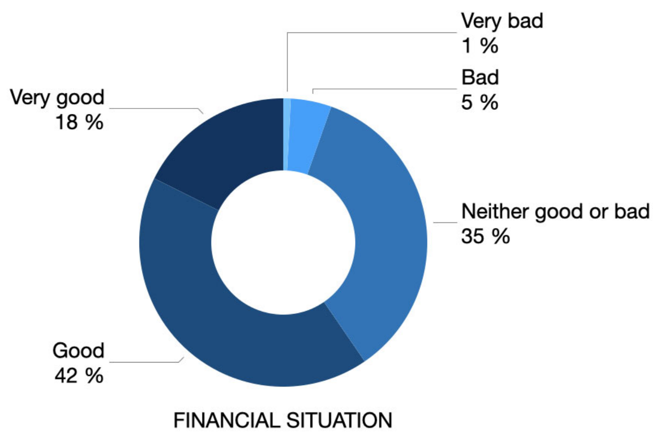


Fig. 4. Survey respondents' WHO-5 index distribution (n = 2496). A score of zero in WHO-5 indicates very poor well-being, and 25 indicates the highest possible well-being. A WHO-5 score below 13 is commonly interpreted as poor well-being. We interpret WHO-5 scores of 17 or higher as indicating high well-being. The average WHO-5 score for the NZ population is 15.9. (Manaaki Whenua Landcare Research 2021).

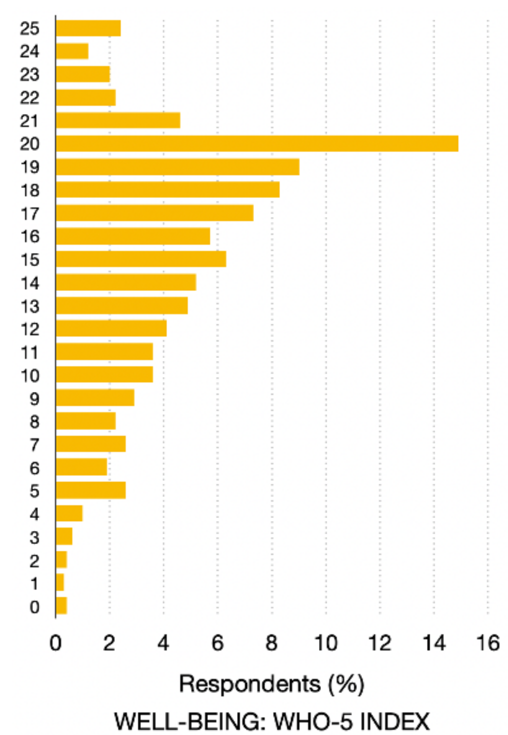


Table 2. Descriptive statistics for the triple outcome farmers, foresters, and growers ("triple outcome," n = 523) and all the other survey respondents ("entire sample," n = 2496). The number of respondents for each variable is reported in parentheses.

Variable	Triple outcome		Entire sample	
	Mean	Min, max	Mean	Min, max
Age (years)	61.48 (510)	26, 86	58.84 (1877)	21, 90
Property area (hectares)	584.80 (523)	0.1, 19212	466.48 (1971)	0.1, 45000
Farm experience (years)	35.41 (514)	0.5, 65	32.96 (1943)	0.5, 65
University degree	45% of respondents (514)		45% of respondents (1952)	
Most common industries	sheep and beef: 43%, dairy: 31%, forestry: 12% (498)		sheep and beef: 50%, dairy: 12%, horticulture: 10% (1856)	
Profitability: break even or profitable	94% (509)		85% (1899)	
Has land not used for production on property	22% (523)		21% (1973)	
Peers as the most helpful social group	47% (518)		45% (1963)	

Descriptive statistics (Table 2) show that the triple outcome group is, on average, older and more experienced, more educated, and more profitable than other respondents. In addition, their properties are larger, on average.

Factors associated with positive outcomes in NZ agriculture and forestry

We conducted four binary logistic regression analyses to investigate which individual- and property-level characteristics correlate with (i) strong environmental performance, (ii) good financial situation, (iii) high well-being, and (iv) all three outcomes combined (Table 3, Figs. 5–8). The pseudo-R-squared statistics indicate that all four models fit the data better than those containing the constant only (Appendix 1 Tables S2–S5). Figures 5–8 present the odds ratios from the perspective of each outcome, whereas the following section reports the results from the perspective of different factors.

Individual traits and views

Individual traits and views emerged as significant independent variables in all four models. Our results (Table 3) show that the personal view on the strength of environmental performance of own property in the future was the only individual-level explanatory variable that significantly correlated with all three outcomes as well as the triple outcome. The correlation was positive for all the outcomes. The similar personal view "it is important to me that the public see farmers, foresters, and growers doing their part for the environment," on the other hand, was not a significant explanatory variable to any of the desirable outcomes. Strikingly, strong environmental performance also correlated significantly with another personal view: believing that climate change is not real was associated with strong environmental performance.

Feeling frequent emotional exhaustion correlated negatively with good financial status, well-being, and the triple outcome, but did not relate to environmental performance. The frequency of feeling physically exhausted was associated with lower odds of high well-being, but not the other outcomes. Further, strong environmental performance was positively correlated with experience. Age, level of education, willingness to experiment with new ideas, and the number of generations that the family has been involved in farming, forestry, or growing food did not significantly correlate with the dependent variables of our models.

Agroecosystem characteristics of the property

Agroecosystem characteristics, too, correlated with all outcomes and the triple outcome. Comparing the odds ratios for agroecosystem characteristics in the four regression models indicates that the area of the property predicted a higher likelihood of strong environmental performance and good financial status but lowered the likelihood of achieving high well-being. Having specific landscape features on the property such as native bush or wetlands was not significantly correlated with strong environmental performance. However, having land on a property that is not suitable for production (e.g., gullies) correlated negatively with a good financial situation and high well-being.

Of the five primary industries included in the models, forestry was associated with strong environmental performance. Sheep and beef, dairying, and horticulture were negatively correlated with well-being. Finally, the results indicate a relationship between the location of the property and good financial situation as well as the triple outcome, but not with high well-being or strong environmental performance (see point estimates for specific regions in Table 3).

Environmental management foci and implemented environmental management practices

Our models included four environmental management foci. Both "managing biosecurity" and "increasing native biodiversity" as environmental management foci correlated positively with strong environmental performance and the triple outcome. Among the implemented environmental management practices, we detected only one statistically significant explanatory variable, namely, reduction of soil erosion was associated with strong environmental performance.

Finances

Whether the farm, forest, or growing operation had been either profitable or break even (in contrast to being unprofitable) in the previous two years is positively correlated with having a good financial situation, high well-being, and the triple outcome. The models show a negative relationship between total debt and good financial status and the triple outcome. Total debt did not statistically correlate with high well-being. Neither profitability nor debt correlated significantly with strong environmental performance.

Table 3. The odds ratios for the regression models with strong environmental performance, financial situation, well-being, and the combination of the tree, i.e., the triple outcomes, as outcome variables. The table includes levels of significance for coefficients. P-values for significance codes are ***: 0–00.1, **: 0.001–0.01, * 0.01–0.05, ".": 0.05–0.1. Odd ratios greater than one indicate that as the explanatory variable increases, the odds of the outcome occurring increase. Odd ratios below one correlate with the odds of the outcome occurrence decreasing. More details on the models and survey questions included as explanatory variables are available in Appendix 1.

	Environmental performance	Financial situation	Well-being	Triple outcome
Individual traits and views				
Age	0.99	0.99	0.95	1.00
Age squared	1.00	1.00	1.00	1.00
Level of education	1.25 .	1.23 .	0.93	1.26
Years of on-farm experience	1.02 **	1.00	0.99	1.00
How many generations family has been involved in agriculture and forestry	1.06	0.98	1.00	1.01
View: strength of environmental performance of own operation in 10 years' time	2.94 ***	1.23 **	1.24 **	2.23 ***
View: it is important that the public see farmers, foresters, and growers doing their part for the environment	0.97	1.04	1.03	1.06
View: climate change is real	0.66 *	1.01	0.95	0.90
Willingness to experiment	0.97	0.99	1.02	0.99
Frequency of physical exhaustion	0.98	1.00	0.67 ***	0.90
Frequency of emotional exhaustion	0.93	0.69 ***	0.25 ***	0.39 ***
Characteristics of the farm, forest, or growing operation				
Area of the property	1.12 *	1.25 ***	0.86 **	1.08
Primary industry: sheep and beef	1.70	0.63	0.45 *	1.62
Primary industry: dairying	1.92 .	1.49	0.35 *	2.33 .
Primary industry: arable farming	2.30 .	0.53	0.47	1.92
Primary industry: horticulture	2.14 .	1.41	0.31 *	1.92
Primary industry: forestry	3.48 **	1.01	0.50	2.34
Waterways on property	0.86	0.95	1.16	0.84
Minor ways and drains on property	0.83	0.96	0.90	0.82
Native bush on property	0.96	1.00	1.14	0.88
Busy road on property	1.17	1.07	0.99	1.12
Land not used for production on property	1.14	0.74 *	0.62 **	1.00
Wetlands on property	1.08	1.00	0.86	0.87
Location: Bay of Plenty	0.95	2.15 *	1.30	2.12
Location: Canterbury	1.26	1.97 *	0.89	2.05
Location: Gisborne	0.80	3.02 *	0.49	1.17
Location: Hawke's Bay	0.80	3.03 **	1.16	3.92 **
Location: Manawatu-Wanganui	0.82	2.58 **	0.69	1.88
Location: Marlborough	1.44	5.45 ***	0.54	2.98 .
Location: Nelson	0.18	8.15 .	1.46	3.53
Location: Northland	1.06	1.88 .	1.04	2.88 *
Location: Otago	0.64	2.43 *	1.02	1.99
Location: Southland	1.20	3.04 **	0.67	3.09 *
Location: Taranaki	1.77	2.33 *	1.19	3.83 **
Location: Tasman	1.82	1.25	0.96	2.77 .
Location: Waikato	1.38	1.57	0.89	2.37 .
Location: Wellington	1.54	2.26 *	0.60	2.69 .
Location: West Coast	2.12	1.38	0.42	1.88
Economic resources				
Profitability	0.92	5.10 ***	1.58 *	2.38 **
Total debt	1.00	0.97 ***	1.00	0.98 ***
Environmental management focus				
Reducing greenhouse gas emissions	1.27 .	1.14	1.31	1.28
Increasing native biodiversity	1.47 **	1.15	1.06	1.51 **
Improving health of waterways	1.09	1.04	1.24	1.11
Reducing soil erosion	0.95	0.86	1.22	1.16
Managing biosecurity	1.70 ***	1.07	1.07	1.56 *
Implemented environmental management practices				
Reducing soil erosion	1.56 **	0.99	0.76 .	0.94
Increasing plant diversity	1.08	0.83	1.20	1.16
Social interactions				
Industry / levy bodies, industry companies and industry events, suppliers, business services and sales advisors (e.g., fertilizer companies)	0.91	0.94	1.24	1.11
Ministry of Primary Industries, other ministries, council, scientists, scientific publications	0.95	0.84	1.13	0.94
Peers and peer support groups	0.87	0.88	1.32 *	0.95
Veterinarians and consultants	0.92	1.08	1.27 .	1.17
Media: books, tv, newspapers, trade magazines, online forums, blogs and social media	0.89	0.85	0.94	0.71 *
Accountants, banks, insurers	0.70 *	1.09	1.28	0.82

Fig. 5. The odds ratios with 95% confidence intervals for significant variables in the regression model for strong or very strong environmental management. The odds ratio indicates the change in odds of the positive outcome (strong or very strong environmental performance) resulting from a unit change in the predictor. Odds ratio > 1 favors positive outcomes; as the predictor increases, the odds of the positive outcome increases. Conversely, odds ratio < 1 indicate decrease in the odds of the positive outcome occurring. In the figure, the word environmental is shortened as “env.”

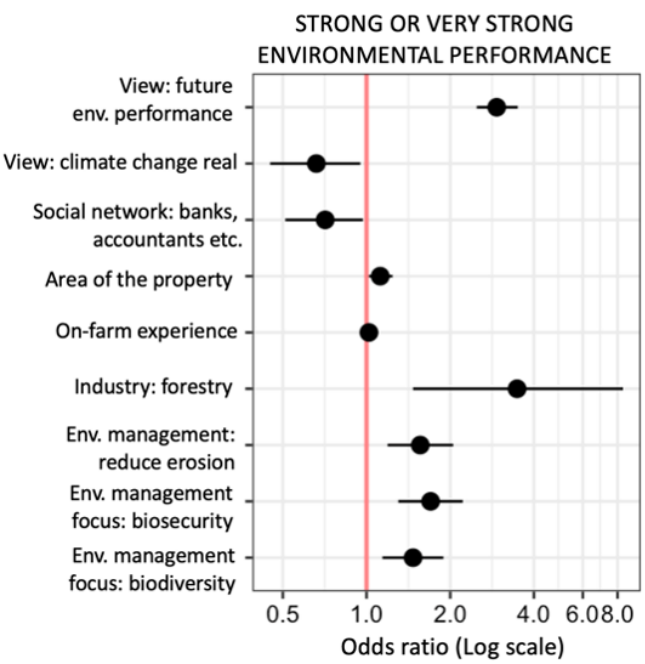
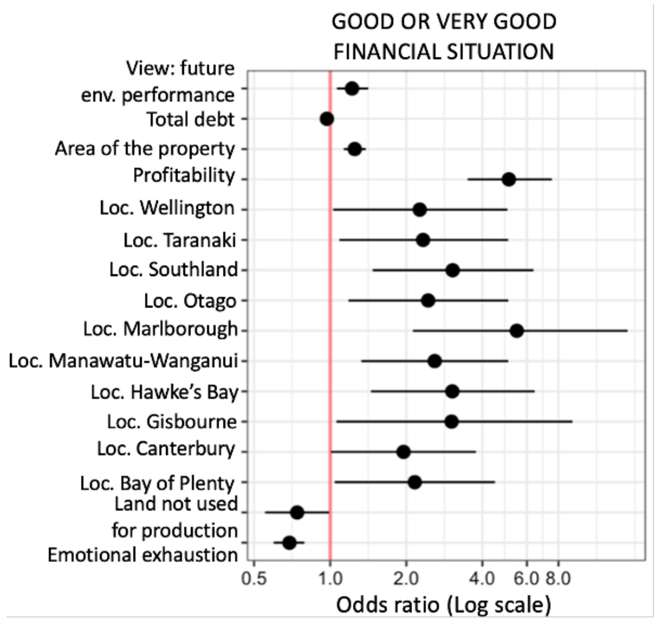


Fig. 6. The odds ratios with 95% confidence intervals for significant variables in the regression model for good or very good financial situation. The odds ratio indicates the change in odds of the positive outcome (good or very good financial situation) resulting from a unit change in the predictor. Odds ratio > 1 favors positive outcomes; as the predictor increases, the odds of the positive outcome increases. Conversely, odds ratio < 1 indicate decrease in the odds of the positive outcome occurring. In the figure, the word environmental is shortened as “env.” and location as “loc.”



Social interactions

Finally, considering peers and peer support groups as the most helpful sources for advice is positively correlated with having high well-being. The other significant social interaction variables in our models correlated negatively with the good financial situation, strong environmental performance, and the triple outcome. Namely, considering social media as the most helpful source of advice correlated negatively with the triple outcome, and having accountants, banks, and insurers as the most helpful source for advice and information correlated negatively with good environmental performance ($p < 0.01$).

DISCUSSION

Our results suggest that despite turbulent times, most farmers, growers, and foresters have been able to achieve at least moderate property-level outcomes in NZ’s current resource regime. Over half of NZ’s land-based natural resource producers achieved environmental, social, or economic outcomes that they themselves considered good or very good. The finding on the majority of producers achieving moderate or better outcomes in at least one sustainability dimension is compelling, since outcome variability between individual natural resource properties may greatly vary (Greer et al. 2008, Cradock-Henry and Fountain 2019).

In so doing, our results indicate general property-level resilience in NZ as the capacity of farmers, growers, and foresters to persist and achieve good or very good outcomes. That said, many producers not able to achieve at least moderate outcomes may have already transitioned to other livelihoods; the total number of farms in NZ has decreased by nearly 30% from 2002 to 2019 (Stats NZ Tatauranga Aotearoa 2021, Ministry for the Environment & Stats NZ 2022). Nevertheless, our results for property-level resilience across primary industry sectors are in agreement with other studies that have reported rural NZ as resilient, including studies from the perspective of financial resilience of farms (Greig et al. 2019), resilience to shocks (Cradock-Henry et al. 2018), and multiple stressors on specific primary industry sector (Cradock-Henry and Fountain 2019). Still, to the authors’ knowledge, this is the first study to estimate NZ’s property-level sustainability (including all three pillars), as conceived by the farmers, growers, and foresters, as well as factors associated with resilience and positive outcomes across several land-based primary industry sectors.

A minority of NZ farmers, growers, and foresters reported bad or very bad outcomes in environmental and financial dimensions. Poor well-being was not more common for NZ farmers, growers, and foresters than for people living in NZ in general (Stats NZ Tatauranga Aotearoa 2022). NZ’s natural resource governance started to pay attention to human well-being mostly in the recent

Fig. 7. The odds ratios with 95% confidence intervals for significant variables in the regression model for high well-being. The odds ratio indicates the change in odds of the positive outcome (high well-being) resulting from a unit change in the predictor. Odds ratio > 1 favors positive outcomes; as the predictor increases, the odds of the positive outcome increases. Conversely, odds ratio < 1 indicate decrease in the odds of the positive outcome occurring. In the figure, the word environmental is shortened as "env."

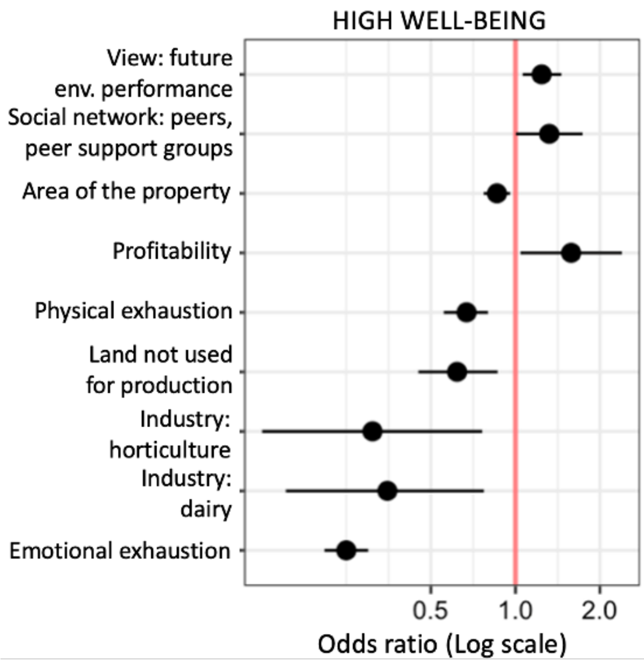
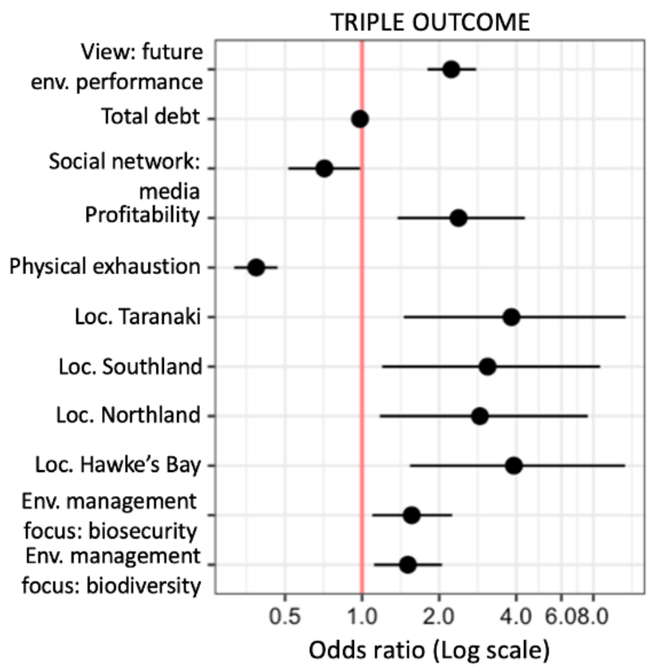


Fig. 8. The odds ratios with 95% confidence intervals for significant variables in the regression model for the triple outcome, i.e., strong or very strong environmental performance, good or very good financial situation, and high well-being. The odds ratio indicates the change in odds of the positive outcome (triple outcome) resulting from a unit change in the predictor. Odds ratio > 1 favors positive outcomes; as the predictor increases, the odds of the positive outcome increases. Conversely, odds ratio < 1 indicate decrease in the odds of the positive outcome occurring. In the figure, the word environmental is shortened as "env." and location as "loc."



decade, e.g., the rural mental health organization Farmstrong NZ was initiated in 2015 (Knook et al. 2023). Thus, our results on less bad or very bad outcomes in environmental and financial than well-being outcomes may reflect NZ's stronger focus in natural resource management on property-level production and environmental outcomes than the well-being of the producer.

All that said, we found that achieving good or very good property-level outcomes in all three dimensions was not common among NZ resource producers, which essentially would indicate the highest level of property-level sustainability. The variables related to the triple outcome were of a self-fulfilling nature in our models. However, our regression analyses for outcome-specific factors provide a plausible explanation for the relatively rare occurrence of these overall well-performing producers. The results show that the three positive outcomes correlate with different factors to the extent that an independent variable can have a positive correlation with one outcome and a negative one with another. For example, property size correlated positively with having a good financial situation but negatively with high well-being. Further, emotional exhaustion, having land unsuitable for production on property, and profitability correlated with having a good financial situation and high well-being (whether positively or negatively) but were not significantly associated with environmental performance. Certain environmental management foci and implemented environmental practices, on the other hand, correlated with environmental performance but not with the property's financial situation or personal well-being. Yet another example is social groups identified as the most helpful sources of advice. None of the social groups included in our study correlated with all three outcomes. Altogether, our study indicates that achieving the triple outcome is difficult; there are a few common property-level drivers to the positive outcomes and some factors have conflicting effects. In other words, there is generally no "winning recipe" identifiable among the triple outcome farmers in our models.

The only factor that significantly and positively correlated with all the three positive outcomes was a plan or ambition to achieve strong environmental performance at own property in the future. The related view "it is important that the public sees farmers, foresters, and growers doing their part for the environment," on the other hand, was not significantly associated with any of the outcomes. Thus, the goal for strong environmental performance may not be due to the social pressure or it may reflect an earlier finding that many resource producers consider the media, not themselves, to be the most impactful influencer of public opinions (Knook et al. 2022). The intriguing finding about the strong future environmental performance of own operation may mean that the

NZ farmers, foresters, and growers who achieved strong or very strong environmental, financial, or well-being outcomes are generally optimistic. The result might suggest that these respondents were optimistic about their current environmental performance, financial situation, and well-being too. Hence, their survey responses on the outcomes of their operation as strong or very strong may be biased by their optimistic view on life. Another explanation can, however, be found in psychology's view on resilience: optimism as a personal trait is one of the strongest determinants of human resilience, together with social connectivity and sense of humor (Walker 2019a). If the survey question on future environmental performance indeed captures optimism, it would be the key determinant in our models for NZ farmers, foresters, and growers' ability to cope and achieve positive outcomes in natural resource production. In any case, NZ primary industry would benefit from including in the sustainability transition the "inner worlds" of people, i.e., emotions, thoughts, identities, and beliefs, e.g., by adopting terminology that is not only scientifically precise but also fosters positive emotions, and by encouraging practices that promote mental health (Ives et al. 2020).

All in all, our results emphasize the importance of measuring the performance of natural resource production simultaneously with environmental, economic, and social objectives (Plagányi et al. 2013). Our results on the difficulty of achieving the triple outcome demonstrates that strengthening ecosystem resilience through good environmental performance does not necessarily translate into greater social outcomes at property-level, or vice versa, or into sustainable natural resource production (Adger 2000, Walker 2019a, 2019b, Yletyinen et al. 2019, Woods et al. 2021). Therefore, as the goal of natural resource management shifts from a singular goal (e.g., profitability) to the multi-faceted sustainability and resilience, natural resource governance must increasingly consider environmental–economic–well-being interdependencies among the factors driving the three outcomes to successfully transition to more sustainable natural resource production. Further, trade-offs associated to sustainability in natural resource management have been detected in natural resource management (especially between nature conservation and economic utilization of the resource), among others in fisheries, forestry, and livestock farming (Plagányi et al. 2013, Castonguay et al. 2023, Mazziotta et al. 2023). The studies on conflicting outcomes often focus on their likely causes, such as resource management strategies, and a few studies have included stakeholders' own perspectives to the conflicts (Klapwijk et al. 2014). Our results, on the other hand, encourage investigating solutions to conflicting outcomes by testing a vast array of factors associated with all three dimensions of sustainability, and including factors that characterize natural resource producers (e.g., personal views, on-farm experience, social connections). Such social factors can provide important leverage points for achieving sustainability outcomes (Yletyinen et al. 2021a). Moreover, the more holistic analyses may capture emergent phenomena, such as the effects of increasingly large properties on well-being of the property owners/managers, and show that neither nature nor economy alone should be the basis of sustainability policies (Berglund 2001). Resource producers typically already consider social-ecological interdependencies, for example, by associating profitability with better work-life balance, or environmental performance with ecosystem resilience and, thus, profitability (Knook et al. 2023). Thus, transitioning to a more sustainable and resilient natural resource production in NZ may benefit from emphasizing the role of natural resource producers as adaptive agents (Gosnell et al. 2020).

Although our study is based on a carefully designed, detailed, national dataset and well-established method, we acknowledge some caveats in the study. Using survey data both limited and provided novel opportunities for explanatory variable selection. For example, knowledge on the property-level management strategy would have enabled coupling the outcomes to the property-specific goals of management, which would have provided further evidence on achieving outcomes desired by the resource producer. Our results on the factors contributing to the triple outcome indicate that the model would have benefitted from independent variables that are known to contribute to mitigating trade-offs, such as external income sources (Mishra et al. 2012), or diversity of crops and harvesting strategies (Klapwijk et al. 2014). Further, while the financial situation is illustrated by the property's bookkeeping and well-being was measured with the well-established WHO-5 index, self-reported environmental performance may be biased by the respondent's knowledge of ecosystem health and need for environmental action. Nonetheless, as stated earlier, NZ farmers, growers, and foresters gain feedback for their environmental performance and in general, being a farmer, forester, or grower requires expertise in ecological processes. Moreover, perceptions provide important evidence about the way resource producers view the outcomes of their actions and can challenge preconceived ideas about their actions and what is important to them (Nicholas-Davies et al. 2020). Finally, it is important to bear in mind that studies like ours must be complemented with larger scale social-ecological systems research to gain a comprehensive understanding on what builds resilience in natural resource production and what kind of property-level outcomes would maintain resilient natural resource systems on regional and national scales (Gunderson and Holling 2004, Darnhofer et al. 2016).

Natural resource management is often characterized by multiple, sometimes conflicting ideas of what sustainability is (Meyfroidt et al. 2022), including the question of whether all three outcomes at properties should be good or just not "bad" for NZ to have sustainable natural resource production. Moreover, resilience is a multi-level concept and individual- or property-level resilience may not translate to regional or national resilience (Leite et al. 2019). Property-level resilience may even hinder transition to more sustainable natural resource production if the transition has not gained social license from NZ farmers, growers, and foresters, since their resilience entails ability of the property to adapt in order to not be changed (Ives et al. 2020, Walker 2020). Our study completes the picture of NZ's rural resilience with property-level investigation for the purpose of studying how NZ natural resource producers are coping, but cross-scale resilience research is needed to understand how the resilience of NZ properties affects the ability of NZ's primary industries to transition to more sustainable production in a fair manner. Gaining knowledge on factors underlying resilience and positive outcomes at property-level is vital especially when natural resource governance is using the broad concepts of resilience and sustainability to focus policy statements and strategies around them (e.g., NZ's Fit for a Better World program [Ministry for Primary Industries 2020]), but lack articulation of the concepts that is clear and detailed enough to be translated into mechanisms that support natural resource production (Roche 2017, Young et al. 2018). Identification of factors that are associated with positive outcomes could contribute to development of specific resilience tools and, consequently, to knowing whether and how managing resilience has been achieved (Young et al. 2018).

Producing food and fiber requires constant adaptation. By utilizing a holistic approach and a pertinent survey data, this study provides new knowledge on the factors associated with positive property-level outcomes in NZ's land-based natural resource production. In conclusion, our results indicate that achieving sustainability as good or very good environmental, economic, and well-being outcomes at property-level is a complex challenge, although not impossible. This study demonstrates that careful consideration for aligning the three sustainability objectives may contribute to decreasing unintended negative impacts of top-down environmental targets or shifts to more sustainable resource production (Plagányi et al. 2013, Woods et al. 2021, McDermott et al. 2023). Understanding and managing the resilience of natural resource producers to environmental and socioeconomic change will contribute to more equitable sustainability transformations (Short et al. 2021, Schuch et al. 2022, McDermott et al. 2023).

Author Contributions:

All authors designed the study. JY conducted the analyses and wrote the initial manuscript. All authors contributed to the final manuscript. PB provided the data and funding for PB and JY. All authors have approved the manuscript for publication.

Data Availability:

The data that support the findings of this study are available on a reasonable request from PSB. The survey data is not publicly available because it contains information that could compromise the privacy of survey participants. Ethical approval for the survey was granted by Manaaki Whenua – Landcare Research under the guidelines of the Code of Ethics developed by the New Zealand Association of Social Science Researchers.

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APPENDIX 1

Title: RESILIENT AND SUSTAINABLE NATURAL RESOURCE PRODUCTION: HOW ARE FARMERS AND FORESTERS COPING?

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This appendix includes:

Table S1: Descriptive statistics for the survey respondents
Table S2: Logistic regression model for the strong environmental performance
Table S3: Logistic regression model for the good financial situation
Table S4: Logistic regression model for the wellbeing
Table S5: Logistic regression model for the triple outcome

Table S1. Descriptive statistics for the survey respondents included in the regression analyses (n = 1672). The right-side column presents the mean and standard deviation (SD) of the responses, or the percentage of respondents who chose each option. In the regression models †: continuous variable, ‡: binary variable, §: categorical variable, |: logarithmic variable.

VARIABLE	RESULTS
Individual traits and views	
Age †	Mean: 59.5 years, SD: 11.63
Level of education ‡	University degree or higher: 48% of the respondents
Years of on-farm experience after age of 18 †	Mean: 33.77, SD: 14.43
How many generations has your family been involved in agriculture or forestry in NZ †	Mean: 3, SD: 1.78
Personal value: "I/we prefer leaving experimenting with new ideas to someone else." §	0: Strongly disagree: 12% 1: 3% 2: 8% 3: 10% 4: 5% 5: 26% 6: 4% 7: 7% 8: 7% 9: 2% 10: Strongly agree: 5%
Personal view: "In my opinion, in 10 years time the environmental performance of my operation should be..." §	Extremely weak: < 1% Weak: < 1% Slightly weak: < 1% Neither weak nor strong: 7% Slightly strong: 13 % Strong: 52% Extremely strong: 27%
Personal value: "it is important to me that the public see farmers, foresters and growers doing their part for the environment." §	0: Strongly disagree: 2% 1: < 1% 2: < 1% 3: 1% 4: 1%

	5: 15% 6: 4% 7: 9 % 8: 19% 9: 8% 10: Strongly agree: 38%
Personal view: Which of the following statement best describes your personal thoughts about climate change? ‡	"Climate change is real.": 88% "Climate change is not real." : 12%
How often do you feel physically exhausted? §	Always: 7% Often: 32% Sometimes: 42% Seldom: 16% Never or almost never: 2%
How often are you feel emotionally exhausted? 1: always, 2: often, 3: sometimes, 4: seldom, 5: never or almost never. §	Always: 16% Often: 35% Sometimes: 28% Seldom: 17% Never or almost never: 4%
Characteristics of the farm, forest, or growing operation	
The total area of the farm, forest or growing operation in hectares |	Mean: 494, SD: 1.89
Which activity do you consider your primary activity? §	Sheep and beef: 49 % Dairy: 29% Horticulture: 10% Forestry: 5% Arable farming: 3% Other livestock: 3%
Does your property include…	Direct access to waterways: 52% Direct access to minor waterways and drains: 72% Native bush not in commercial use: 52% Wetlands: 37% Other land not used for production: 24% Frontage of a busy road: 45%
Economic resources	
In general, how profitable has the farm, forest or growing operation been in the past 2 years? ‡ (converted in regression analyses to a binary variable: profitable or break even, or unprofitable)	Unprofitable: 12% Break even: 31% Profitable: 57%
Approximately what (percentage) is the total debt in relation to the total value of owned land, productive assets, and other capital, excluding seasonal borrowing? §	0: 26% 1-10: 14% 11-20: 13% 21-30: 13% 31-40: 11% 41-50: 10% 51-60: 7% 61-70: 4% 71-80: 2 % 81-90: < 1% 91-100: < 1%
Environmental management focus	
How much focus has there been on implementing or maintaining practices to achieve the following outcomes? ‡	Moderate focus or major focus on: Reducing greenhouse gas emissions: 28% Increasing native biodiversity on the property: 47% Improving the health of the waterways: 73% Reducing soil erosion: 63% Managing biosecurity on the property: 71%

Which of the following management practices have been implemented on your farm, forest, or growing operation? Select all that apply. (All answer options not included in the analysis, since they were not applicable on all properties, e.g. grazing management.) ‡	Manage erosion / sediments: 65% Increase plant diversity: 36%
Social interactions	
Which of the following sources of advice and information do you consider to be the most helpful? Select up to three. ‡ (For the regression analyses, we aggregated the 19 social groups included in the survey question as follows. "Peers" include peers and peer support groups. "Industry and business" group include industry and levy bodies, industry companies and industry events, suppliers, business services and sales advisors. "Government and scientists" group includes social actors who provide guidance and regulation, but do not (at least directly) benefit economically from the interactions, i.e. NZ Ministry of Primary Industries and councils, as well as scientists and scientific publications. Veterinarians and consultants form a group because farmers, growers and foresters pay for their help and advices. Accountants, banks and insurers provide personal economic guidance. "Media" group includes books, tv, newspaper, trade magazines, online forums, blogs, and social media.)	Peers and peer support groups: 46% Veterinarians: 36% Industry / levy bodies: 30% Trade magazines, books: 26% Industry events, show field days: 25% Scientists, scientific publications: 23% Industry companies, suppliers: 13% Accountants, banks, insurers: 18% Fee-for-service rural consultants: 18% Business services / sales advisors: 5% Blogs: 4% TV, radio, newspapers: 3% Facebook: 2% Local / regional council: 2% Online forums: 2% YouTube: 2% Ministry for Primary Industries: 1% Other ministries: < 1% Other social media: < 1%

Table S2: Logistic regression model for the strong environmental performance outcome. The table presents coefficients and the standard errors (SE) and levels of significance, odds ratios (OR), and 95% confidence intervals (CI) for the odd ratios. P-values for significance codes are ***: 0 – 00.1, **: 0.001 – 0.01, * 0.01 – 0.05, '.': 0.05 – 0.1. Pseudo R-Squareds = 0.202 (Hosmer and Lemeshow), 0.243 (Cox and Snell), 0.325 (Nagelkerke). Multicollinearity was not detected. AIC = 1946.3.

	B (SE)	ODDS RATIO	OR CI: LOWER	OR CI: HIGHER
Intercept	-7.56 (1.30) ***			
INDIVIDUAL TRAITS AND VIEWS				
Age	-0.01 (0.04)	0.99	0.92	1.06
Age squared	0.00 (0.00)	1.00	1.00	1.00
Level of education	0.23 (0.13) .	1.25	0.98	1.60
Years of on-farm experience	0.02 (0.01) **	1.02	1.00	1.03
How many generations family has been involved in agriculture and forestry	0.06 (0.03)	1.06	0.99	1.13
View: strength of environmental performance of own operation in 10 years' time	1.08 (0.09) ***	2.94	2.49	3.50
View: it is important that the public see farmers, foresters and growers doing their part for the environment	-0.03 (0.03)	0.97	0.91	1.02
View: climate change is real	-0.42 (0.19) *	0.66	0.45	0.95
Willingness to experiment	-0.03 (0.02)	0.97	0.93	1.02
Frequency of physical exhaustion	-0.02 (0.08)	0.98	0.84	1.16
Frequency of emotional exhaustion	-0.08 (0.07)	0.93	0.80	1.07

CHARACTERISTICS OF THE FARM, FOREST, OR GROWING OPERATION				
Area of the property	0.12 (0.05) *	1.12	1.02	1.24
Primary industry: sheep and beef	0.53 (0.35)	1.70	0.86	3.39
Primary industry: dairying	0.65 (0.36) .	1.92	0.95	3.92
Primary industry: arable farming	0.83 (0.48) .	2.30	0.91	5.93
Primary industry: horticulture	0.76 (0.40) .	2.14	0.99	4.7
Primary industry: forestry	1.25 (0.44) **	3.48	1.47	8.37
Waterways on property	-0.15 (0.12)	0.86	0.67	1.10
Minor ways and drains on property	-0.18 (0.13)	0.83	0.64	1.08
Native bush on property	-0.04 (0.15)	0.96	0.72	1.27
Busy road on property	0.16 (0.12)	1.17	0.93	1.48
Land not used for production on property	0.13 (0.15)	1.14	0.85	1.54
Wetlands on property	0.07 (0.14)	1.08	0.81	1.42
Location: Bay of Plenty	-0.05 (0.38)	0.95	0.45	2.01
Location: Canterbury	0.23 (0.35)	1.26	0.63	2.51
Location: Gisborne	-0.23 (0.54)	0.80	0.27	2.30
Location: Hawke's Bay	-0.22 (0.38)	0.80	0.38	1.70
Location: Manawatu-Wanganui	-0.19 (0.36)	0.82	0.41	1.65
Location: Marlborough	0.36 (0.47)	1.44	0.58	3.62
Location: Nelson	-1.74 (1.38)	0.18	0.01	1.93
Location: Northland	0.06 (0.36)	1.06	0.52	2.15
Location: Otago	-0.44 (0.38)	0.64	0.30	1.36
Location: Southland	0.18 (0.39)	1.20	0.56	2.55
Location: Taranaki	0.57 (0.41)	1.77	0.79	4.01
Location: Tasman	0.60 (0.46)	1.82	0.74	4.57
Location: Waikato	0.33 (0.34)	1.38	0.71	2.69
Location: Wellington	0.43 (0.43)	1.54	0.67	3.57
Location: West Coast	0.75 (0.54)	2.12	0.73	6.25
ECONOMIC RESOURCES				
Profitability	-0.08 (0.19)	0.92	0.63	1.34
Total debt	0.00 (0.00)	1.00	0.99	1.00
ENVIRONMENTAL MANAGEMENT FOCUS				
Reducing greenhouse gas emissions	0.24 (0.14) .	1.27	0.96	1.67
Increasing native biodiversity	0.38 (0.13) **	1.47	1.14	1.89
Improving health of waterways	0.08 (0.15)	1.09	0.80	1.47
Reducing soil erosion	-0.05 (0.14)	0.95	0.73	1.25
Managing biosecurity	0.53 (0.14) ***	1.70	1.30	2.22
IMPLEMENTED ENVIRONMENTAL MANAGEMENT PRACTICES				
Reducing soil erosion	0.45 (0.14) **	1.56	1.19	2.05
Increasing plant diversity	0.08 (0.13)	1.08	0.84	1.40
SOCIAL INTEACTIONS				
Industry / levy bodies, industry companies and industry events, suppliers, business services and sales advisors (e,g, fertilizer companies)	-0.09 (0.13)	0.91	0.71	1.17
Ministry of Primary Industries, other ministries, council, scientists, scientific publications	-0.05 (0.14)	0.95	0.72	1.26
Peers and peer support groups	-0.14 (0.13)	0.87	0.67	1.11
Veterinarians and consultants	-0.08 (0.13)	0.92	0.71	1.19
Media: books, tv, newspapers, trade magazines, online forums, blogs and social media	-0.12 (0.13)	0.89	0.68	1.15
Accountants, banks, insurers	-0.35 (0.16) *	0.70	0.51	0.97

Table S3: Logistic regression model for the good financial situation outcome. The table presents coefficients and the standard errors (SE) and levels of significance, odds ratios, and confidence intervals (CI) for the odd ratios. P-values for significance codes are ***: 0 – 00.1, **: 0.001 – 0.01, * 0.01 – 0.05, '.': 0.05 – 0.1. Pseudo R-Squareds = 0.157 (Hosmer and Lemeshow), 0.189 (Cox and Snell), 0.257 (Nagelkerke). Multicollinearity was not detected. AIC = 1993.4

	B (SE)	ODDS RATIO	95% CI: LOWER	95% CI: HIGHER
Intercept	1.86 (1.23)			
INDIVIDUAL TRAITS AND VIEWS				
Age	-0.01 (0.04)	0.99	0.92	1.06
Age squared	0.00 (0.00)	1.00	1.00	1.00
Level of education	0.21 (0.12) .	1.23	0.97	1.57
Years of on-farm experience	0.00 (0.01)	1.00	0.99	1.01
How many generations family has been involved in agriculture and forestry	-0.02 (0.03)	0.98	0.92	1.05
View: strength of environmental performance of own operation in 10 years' time	0.20 (0.07) **	1.23	1.06	1.42
View: it is important that the public see farmers, foresters and growers doing their part for the environment	0.04 (0.03)	1.04	0.99	1.10
View: climate change is real	0.03 (0.18)	1.01	0.71	1.44
Willingness to experiment	-0.01 (0.02)	0.99	0.95	1.04
Frequency of physical exhaustion	0.00 (0.08)	1.00	0.85	1.17
Frequency of emotional exhaustion	-0.37 (0.07) ***	0.69	0.60	0.79
CHARACTERISTICS OF THE FARM, FOREST, OR GROWING OPERATION				
Area of the property	0.22 (0.05) ***	1.25	1.13	1.38
Primary industry: sheep and beef	-0.47 (0.33)	0.63	0.33	1.21
Primary industry: dairying	0.40 (0.35)	1.49	0.76	2.95
Primary industry: arable farming	-0.64 (0.46)	0.53	0.21	1.29
Primary industry: horticulture	0.33 (0.38)	1.41	0.66	3.00
Primary industry: forestry	0.00 (0.42)	1.01	0.44	2.30
Waterways on property	-0.04 (0.12)	0.95	0.75	1.21
Minor ways and drains on property	-0.04 (0.13)	0.96	0.74	1.25
Native bush on property	0.00 (0.14)	1.00	0.76	1.33
Busy road on property	0.07 (0.12)	1.07	0.84	1.34
Land not used for production on property	-0.30 (0.15) *	0.74	0.55	0.99
Wetlands on property	0.00 (0.14)	1.00	0.76	1.33
Location: Bay of Plenty	0.77 (0.37) *	2.15	1.04	4.48
Location: Canterbury	0.67 (0.34) *	1.97	1.02	3.81
Location: Gisborne	1.11 (0.55) *	3.02	1.06	9.08
Location: Hawke's Bay	1.11 (0.38) **	3.03	1.44	6.42
Location: Manawatu-Wanganui	0.95 (0.34) **	2.58	1.32	5.04
Location: Marlborough	1.70 (0.50) ***	5.45	2.12	14.97
Location: Nelson	2.10 (1.23) .	8.15	0.96	181.69
Location: Northland	0.63 (0.35) .	1.88	0.95	3.70
Location: Otago	0.89 (0.37) *	2.43	1.18	5.04
Location: Southland	1.12 (0.37) **	3.04	1.47	6.35
Location: Taranaki	0.85 (0.39) *	2.33	1.08	5.05
Location: Tasman	0.22 (0.43)	1.25	0.53	2.93
Location: Waikato	0.46 (0.32)	1.57	0.83	2.97
Location: Wellington	0.82 (0.40) *	2.26	1.03	5.03
Location: West Coast	0.32 (0.51)	1.38	0.51	3.78

ECONOMIC RESOURCES				
Profitability	1.63 (0.20) ***	5.10	3.50	7.54
Total debt	-0.03 (0.00) ***	0.97	0.96	0.98
ENVIRONMENTAL MANAGEMENT FOCUS				
Reducing greenhouse gas emissions	0.13 (0.14)	1.14	0.86	1.49
Increasing native biodiversity	0.13 (0.13)	1.15	0.89	1.48
Improving health of waterways	0.03 (0.15)	1.04	0.77	1.40
Reducing soil erosion	-0.15 (0.14)	0.86	0.66	1.13
Managing biosecurity	0.07 (0.14)	1.07	0.82	1.40
IMPLEMENTED ENVIRONMENTAL MANAGEMENT PRACTICES				
Reducing soil erosion	-0.01 (0.14)	0.99	0.75	1.30
Increasing plant diversity	-0.19 (0.13)	0.83	0.64	1.06
SOCIAL INTERACTIONS				
Industry / levy bodies, industry companies and industry events, suppliers, business services and sales advisors (e,g, fertilizer companies)	-0.07 (0.12)	0.94	0.73	1.19
Ministry of Primary Industries, other ministries, council, scientists, scientific publications	-0.17 (0.14)	0.84	0.64	1.11
Peers and peer support groups	-0.12 (0.13)	0.88	0.69	1.13
Veterinarians and consultants	0.07 (0.13)	1.08	0.84	1.38
Media: books, tv, newspapers, trade magazines, online forums, blogs and social media	-0.16 (0.13)	0.85	0.66	1.10
Accountants, banks, insurers	0.08 (0.16)	1.09	0.80	1.50

Table S4: Logistic regression model for the high wellbeing outcome. The table presents coefficients and the standard errors (SE) and levels of significance, odds ratios, and confidence intervals (CI) for the odd ratios. P-values for significance codes are ***: 0 – 00.1, **: 0.001 – 0.01, * 0.01 – 0.05, '.': 0.05 – 0.1. Pseudo R-Squareds = 0.321 (Hosmer and Lemeshow), 0.359 (Cox and Snell), 0.479 (Nagelkerke). Multicollinearity was not detected. AIC = 1679.4

	B (SE)	ODDS RATIO	95% CI: LOWER	95% CI: HIGHER
Intercept	4.03 (1.40)			
INDIVIDUAL TRAITS AND VIEWS				
Age	-0.05 (0.04)	0.95	0.87	1.03
Age squared	0.00 (0.00)	1.00	1.00	1.00
Level of education	-0.07 (0.14)	0.93	0.71	1.22
Years of on-farm experience	-0.01 (0.01)	0.99	0.98	1.01
How many generations family has been involved in agriculture and forestry	0.00 (0.04)	1.00	0.93	1.08
View: strength of environmental performance of own operation in 10 years' time	0.22 (0.08) **	1.24	1.06	1.46
View: it is important that the public see farmers, foresters and growers doing their part for the environment	0.03 (0.03)	1.03	0.97	1.10
View: climate change is real	-0.05 (0.21)	0.95	0.63	1.45
Willingness to experiment	0.02 (0.02)	1.02	0.97	1.07
Frequency of physical exhaustion	-0.40 (0.09) ***	0.67	0.56	0.80

Frequency of emotional exhaustion	-1.38 (0.09) ***	0.25	0.21	0.30
CHARACTERISTICS OF THE FARM, FOREST, OR GROWING OPERATION				
Area of the property	-0.15 (0.06) **	0.86	0.77	0.96
Primary industry: sheep and beef	-0.79 (0.40) *	0.45	0.20	0.99
Primary industry: dairying	-1.06 (0.41) *	0.35	0.15	0.77
Primary industry: arable farming	-0.76 (0.54)	0.47	0.16	1.35
Primary industry: horticulture	-1.16 (0.46) *	0.31	0.13	0.76
Primary industry: forestry	-0.68 (0.50)	0.50	0.19	1.33
Waterways on property	0.15 (0.14)	1.16	0.89	1.52
Minor ways and drains on property	-0.10 (0.15)	0.90	0.67	1.21
Native bush on property	0.13 (0.16)	1.14	0.83	1.56
Busy road on property	-0.01 (0.13)	0.99	0.76	1.28
Land not used for production on property	-0.47 (0.17) **	0.62	0.45	0.86
Wetlands on property	-0.15 (0.16)	0.86	0.63	1.17
Region: Bay of Plenty	0.26 (0.41)	1.30	0.57	2.92
Region: Canterbury	-0.12 (0.37)	0.89	0.43	1.84
Region: Gisborne	-0.71 (0.59)	0.49	0.16	1.57
Region: Hawke's Bay	0.15 (0.41)	1.16	0.52	2.60
Region: Manawatu-Wanganui	-0.38 (0.38)	0.69	0.33	1.44
Region: Marlborough	-0.62 (0.50)	0.54	0.20	1.44
Region: Nelson	0.38 (1.16)	1.46	0.17	19.45
Region: Northland	0.04 (0.39)	1.04	0.49	2.21
Region: Otago	0.02 (0.41)	1.02	0.46	2.27
Region: Southland	-0.40 (0.42)	0.67	0.30	1.51
Region: Taranaki	0.18 (0.44)	1.19	0.50	2.82
Region: Tasman	-0.04 (0.48)	0.96	0.37	2.47
Region: Waikato	-0.12 (0.36)	0.89	0.44	1.79
Region: Wellington	-0.51 (0.45)	0.60	0.25	1.46
Region: West Coast	-0.86 (0.58)	0.42	0.13	1.32
ECONOMIC RESOURCES				
Profitability	0.46 (0.21) *	1.58	1.04	2.40
Total debt	0.00 (0.00)	1.00	0.99	1.00
ENVIRONMENTAL MANAGEMENT FOCUS				
Reducing greenhouse gas emissions	0.27 (0.16)	1.31	0.97	1.78
Increasing native biodiversity	0.06 (0.15)	1.06	0.80	1.41
Improving health of waterways	0.22 (0.17)	1.24	0.89	1.75
Reducing soil erosion	0.20 (0.15)	1.22	0.90	1.65
Managing biosecurity	0.06 (0.15)	1.07	0.79	1.44
IMPLEMENTED ENVIRONMENTAL MANAGEMENT PRACTICES				
Reducing soil erosion	-0.27 (0.16) .	0.76	0.56	1.04
Increasing plant diversity	0.18 (0.14)	1.20	0.90	1.60
SOCIAL INTERACTIONS				
Industry / levy bodies, industry companies and industry events, suppliers, business services and sales advisors (e,g, fertilizer companies)	0.21 (0.14)	1.24	0.94	1.63
Ministry of Primary Industries, other ministries, council, scientists, scientific publications	0.12 (0.16)	1.13	0.83	1.53
Peers and peer support groups	0.28 (0.14) *	1.32	1.00	1.74
Veterinarians and consultants	0.24 (0.15) .	1.27	0.96	1.69
Media: books, tv, newspapers, trade magazines, online forums, blogs and social media	-0.06 (0.15)	0.94	0.71	1.26
Accountants, banks, insurers	0.24 (0.18)	1.27	0.90	1.80

Table S5: Logistic regression model for the triple outcome (strong environmental performance, good financial situation and high wellbeing). The table presents coefficients and the standard errors (SE) and levels of significance, odds ratios, and confidence intervals for the odd ratios. P-values for significance codes are ***: 0 – 00.1, **: 0.001 – 0.01, * 0.01 – 0.05, '.': 0.05 – 0.1. Model Pseudo R-Squareds = 0.232 (Hosmer and Lemeshow), 0.216 (Cox and Snell), 0.332 (Nagelkerke). Multicollinearity was not detected. AIC = 1451.5

	B (SE)	ODDS RATIO	95% CI: LOWER	95% CI: HIGHER
Intercept	-7.83 (1.77)			
INDIVIDUAL TRAITS AND VIEWS				
Age	0.00 (0.05)	1.00	0.91	1.10
Age squared	0.00 (0.00)	1.00	1.00	1.00
Level of education	0.23 (0.15)	1.26	0.94	1.69
Years of on-farm experience	0.00 (0.01)	1.00	0.99	1.02
How many generations family has been involved in agriculture and forestry	0.01 (0.04)	1.01	0.93	1.10
View: strength of environmental performance of own operation in 10 years' time	0.80 (0.11) ***	2.23	1.80	2.79
View: it is important that the public see farmers, foresters and growers doing their part for the environment	0.06 (0.04)	1.06	0.99	1.14
View: climate change is real	-0.11 (0.24)	0.90	0.56	1.46
Willingness to experiment	-0.01 (0.03)	0.99	0.94	1.04
Frequency of physical exhaustion	-0.11 (0.10)	0.90	0.73	1.09
Frequency of emotional exhaustion	-0.95 (0.10) ***	0.39	0.32	0.47
CHARACTERISTICS OF THE FARM, FOREST, OR GROWING OPERATION				
Area	0.07 (0.06)	1.08	0.96	1.21
Primary industry: sheep and beef	0.48 (0.48)	1.62	0.67	4.45
Primary industry: dairying	0.85 (0.49) .	2.33	0.93	6.53
Primary industry: arable farming	0.65 (0.63)	1.92	0.56	6.74
Primary industry: horticulture	0.65 (0.52)	1.92	0.72	5.68
Primary industry: forestry	0.85 (0.55)	2.34	0.82	7.31
Waterways on property	-0.17 (0.15)	0.84	0.62	1.13
Minor ways and drains on property	-0.19 (0.16)	0.82	0.60	1.13
Native bush on property	-0.13 (0.17)	0.88	0.63	1.23
Busy road on property	0.11 (0.15)	1.12	0.84	1.48
Land not used for production on property	0.00 (0.18)	1.00	0.69	1.43
Wetlands on property	-0.14 (0.17)	0.87	0.62	1.22
Region: Bay of Plenty	0.75 (0.49)	2.12	0.84	5.72
Region: Canterbury	0.72 (0.46)	2.05	0.85	5.34
Region: Gisborne	0.16 (0.70)	1.17	0.28	4.52
Region: Hawke's Bay	1.36 (0.49) **	3.92	1.54	10.64
Region: Manawatu-Wanganui	0.63 (0.47)	1.88	0.77	4.92
Region: Marlborough	1.09 (0.57) .	2.98	0.99	9.25
Region: Nelson	1.26 (1.39)	3.53	0.13	42.64
Region: Northland	1.06 (0.47) *	2.88	1.17	7.60
Region: Otago	0.69 (0.51)	1.99	0.75	5.58
Region: Southland	1.13 (0.50) *	3.09	1.20	8.50
Region: Taranaki	1.34 (0.51) **	3.83	1.46	10.69
Region: Tasman	1.02 (0.55) .	2.77	0.96	8.34
Region: Waikato	0.86 (0.45) .	2.37	1.02	5.98

Region: Wellington	0.99 (0.53) .	2.69	0.96	7.87
Region: West Coast	0.63 (0.73)	1.88	0.42	7.55
ECONOMIC RESOURCES				
Profitability	0.87 (0.29) **	2.38	1.37	4.32
Total debt	-0.02 (0.00) ***	0.98	0.97	0.99
ENVIRONMENTAL MANAGEMENT FOCUS				
Reducing greenhouse gas emissions	0.24 (0.16)	1.28	0.93	1.74
Increasing native biodiversity	0.41 (0.16) **	1.51	1.11	2.05
Improving health of waterways	0.10 (0.20)	1.11	0.75	1.64
Reducing soil erosion	0.15 (0.17)	1.16	0.83	1.63
Managing biosecurity	0.45 (0.18) *	1.56	1.10	2.25
IMPLEMENTED ENVIRONMENTAL MANAGEMENT PRACTICES				
Reducing soil erosion	-0.06 (0.17)	0.94	0.67	1.33
Increasing plant diversity	0.15 (0.16)	1.16	0.85	1.57
SOCIAL INTERACTIONS				
Industry / levy bodies, industry companies and industry events, suppliers, business services and sales advisors (e,g, fertilizer companies)	0.10 (0.15)	1.11	0.82	1.49
Ministry of Primary Industries, other ministries, council, scientists, scientific publications	-0.07 (0.17)	0.94	0.67	1.30
Peers and peer support groups	-0.05 (0.15)	0.95	0.71	1.29
Veterinarians and consultants	0.15 (0.16)	1.17	0.85	1.59
Media: books, tv, newspapers, trade magazines, online forums, blogs and social media	-0.34 (0.16) *	0.71	0.52	0.98
Accountants, banks, insurers	-0.19 (0.20)	0.82	0.55	1.22