Regenerative Farm Blueprint

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Strategic Partners:

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1 Executive Summary

Aims & Objectives

The study examines how New Zealand's agricultural sector can integrate business strategy, regenerative design, and sustainability legislation to create regenerative farm blueprints that enhance Freshwater Farm Plans (FWFPs). These blueprints aim to thoroughly evaluate environmental impacts and tailor practices to individual farmers' strengths, promoting sustainable farming methods that preserve freshwater ecosystems and support long-term ecological health, economic viability, and social well-being.

Background:

New Zealand's agriculture industry faces increasing pressure to demonstrate sustainable food and fibre production to satisfy export markets and local communities while grappling with rising regulatory demands and the financial risks of non-compliance. Stakeholders call for more detailed non-financial information, making non-financial reporting (NFR) an essential tool for managing non-financial risks, meeting trade requirements, and communicating effectively. This study aims to integrate business strategy, regenerative design, and sustainability legislation to create regenerative farm blueprints that enhance Freshwater Farm Plans (FWFPs), promoting sustainable farming methods that preserve freshwater ecosystems and support long-term environmental health, economic viability, and social well-being.

Methodology

This study included a thorough literature review to provide context on sustainable farming practices. A survey with 22 long-answer questions was conducted, divided into seven sections targeting specific aspects of sustainable farming. Insights were gathered from 161 participants in agriculture and scientific fields. Thematic analysis techniques were employed to ensure validity and gain a detailed understanding of participants' perspectives. The goal was to triangulate knowledge between farming professionals and literature, enabling a SWOT analysis for developing the Regenerative Farming Blueprint.

Key Findings

The thematic analysis revealed several critical themes, providing valuable insights into the study's problem:

1. **Regenerative Practices:** Mentioned 280 times, these practices emphasise holistic management principles and adaptive strategies. Participants noted benefits such as improved soil health and biodiversity but highlighted challenges like financial barriers and resistance to change.

2. **Soil and Water Management:** With 1123 mentions, this category was most frequently discussed, underscoring its critical importance. Key themes included soil health, effective water management practices, integration strategies, and significant regulatory and resource challenges. This indicates the need for targeted support and resources to overcome these obstacles.

3. **Biodiversity:** This theme, highlighted by 720 mentions, underscores biodiversity's essential role in ecological health and farm resilience. However, challenges such as cost constraints

and a lack of awareness were noted, suggesting increased education and financial incentives were needed.

4. **Legislation and Compliance:** Mentioned 177 times; this reflects concerns about regulatory impacts and the necessity for better understanding and support for compliance. This indicates more explicit guidelines and support mechanisms to help farmers meet regulatory requirements.
5. **Financial and Economic Factors:** This theme, which also received 177 mentions, emphasises the importance of financial management and investment in sustainable practices. It suggests that economic incentives and financial support are crucial for adopting sustainable farming methods.

These findings indicate that while adopting regenerative practices has significant benefits, it also presents considerable challenges that must be addressed through targeted support, education, and financial incentives. This comprehensive approach is essential for successfully integrating sustainable practices in New Zealand's agricultural sector.

Recommendations for Farmers

1. **Identify Relevant Non-Financial KPIs:** For comprehensive effectiveness, incorporate metrics like soil health, water usage efficiency, biodiversity, and carbon footprint into business planning.
2. **Engage Advisory Support:** Collaborate with trusted advisors to implement robust non-financial reporting systems tracking sustainability progress.
3. **Provide Balanced Reporting:** Include detailed non-financial reports, such as environmental impact assessments and sustainability audits, alongside financial results for a complete view of farm performance.
4. **Engage Employees in Sustainability:** To foster a culture of sustainability, train employees on regenerative farming practices and involve them in sustainability initiatives.
5. **Benchmark Sustainability:** Regularly assess your farm's sustainability performance against industry standards and best practices to understand and improve your position on the sustainability curve.

Recommendations for Stakeholders

1. **Engage Early with Farmers:** Proactively communicate about upcoming compliance requirements and provide clear, actionable guidance to ensure early engagement and buy-in.
2. **Build Advisory Capability:** Enhance advisors' skills and knowledge through specialized training programs focused on regenerative farming techniques and sustainability practices.
3. **Use Technology Effectively:** Invest in advanced technology systems, such as precision agriculture tools and digital platforms, to simplify and streamline farmer reporting processes.
4. **Support Early Adopters:** Provide targeted financial assistance, such as grants or low-interest loans, and recognise leaders in sustainable practices through certifications or market premiums to incentivise early adoption of regenerative farming methods.

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3 Introduction

This study examines the intersection of business strategy, regenerative design, and sustainability legislation within New Zealand's agricultural sector to create regenerative farm blueprints. These blueprints aim to enhance traditional Freshwater Farm Plans (FWFPs) by providing comprehensive guidance for farmers transitioning to regenerative practices. The objective is to evaluate environmental impacts thoroughly and tailor practices to individual farmers' strengths while seizing market opportunities. By integrating legislative frameworks, regenerative design principles, FWFP goals, and business strategies, this study seeks to address the specific needs of New Zealand pastoral farmers and enhance understanding of how these factors contribute to environmental sustainability.

Freshwater resources are vital to New Zealand's environmental and economic sustainability. The development of FWFPs addresses the ecological risks associated with farming activities, promoting sustainable practices while preserving freshwater ecosystems. These plans draw from various sources, including the Resource Management Act and industry best practices, to manage on-farm environmental risks and integrate Good Management Practices (GMPs). However, challenges such as biodiversity loss and water pollution necessitate a shift towards more sustainable methods. Integrating regenerative farming principles into FWFPs involves creating a regenerative farm blueprint that guides farmers in designing and implementing systems to restore and enhance natural ecosystems, fostering a holistic approach that supports long-term environmental health, economic viability, and social well-being.

Integrating these elements into a cohesive framework provides a pathway for transitioning New Zealand's agricultural practices towards greater sustainability. This study explores innovative approaches such as silvopasture, which integrates trees and shrubs with livestock grazing systems to diversify production and improve habitat quality. By addressing the diverse needs of stakeholders and aligning with global trends favouring sustainability, this study aims to create balanced and resilient agricultural systems that mimic natural ecosystems, ultimately ensuring long-term sustainability and productivity in New Zealand's agricultural sector.

4 Aim

This study aims to enhance existing Freshwater Farm Plan (FWFP) reports by developing regenerative farm blueprints that integrate legislative frameworks, regenerative design principles, and strategic business approaches. Tailored to the needs of small to medium-sized agricultural enterprises, these blueprints seek to refine guidelines for creating FWFPs, ensuring comprehensive and sustainable farming practices. By triangulating knowledge from a thorough literature review and a detailed survey of agricultural and scientific professionals, the study provides practical insights for immediate application. This approach addresses key challenges such as soil health management, efficient water management, and biodiversity conservation, ultimately promoting resilient agricultural systems that mimic natural ecosystems and ensuring long-term sustainability and productivity.

5 Literature Review

5.1 Regenerative Farming Potential

New Zealand has long been celebrated internationally for its reputation as a producer of *'clean and green'* agricultural products. New Zealand's primary production strategy is increasingly focused on targeting high-value overseas markets by leveraging its strengths in quality and sustainability (MPI 2024). The government has set ambitious targets to reduce methane emissions and achieve net-zero greenhouse gases by 2050, detailed in the Emissions Reduction Plan (MPI 2024). This plan includes measures to assist farmers in reducing emissions, developing climate mitigation technologies, and enhancing forestry's role in carbon sequestration.

New Zealand is renowned for its premium agricultural products, particularly dairy, meat, and wood, significantly contributing to its export economy (MoE 2023c). For instance, Fonterra, a leading dairy cooperative, exports to over 130 countries, representing 25% of New Zealand's total exports (Fonterra 2022). This strong reputation for high-quality products positions New Zealand favourably in discerning markets in Europe, North America, and Asia (PWC 2023; MFAT 2024a). In today's global market, there is a growing imperative to investigate the environmental impact of exports, driven by heightened consumer awareness and demand for eco-friendly goods (Reichheld 2023). Research indicates that businesses integrating eco-friendly initiatives gain a competitive edge by meeting consumer expectations and regulatory standards (Wu and Hobbs 2007; de Souza Barbosa *et al.* 2023).

However, this acclaim can contrast with documented environmental degradation from conventional farming practices, which includes biodiversity loss, habitat transformation, and water pollution (Meurk and Swaffield 2000; Joy 2015; MacLeod *et al.* 2022). Domestically, the dairy industry in New Zealand faces mounting criticism due to its significant environmental footprint, prompting calls for reduced environmental impact (Baskaran *et al.* 2009; Norton *et al.* 2020). In a survey of various agricultural sectors in New Zealand, concerns were expressed regarding the impact of farming on water quality, the reliance on monoculture-based intensive production systems, and the lack of biodiversity and value-added commodities (Grelet *et al.* 2021).

The intensification of agriculture globally has been detrimental to biodiversity, with New Zealand's pastoral farms experiencing a substantial decline in terrestrial biodiversity (Kok *et al.* 2018). In particular, transforming diverse forests into pastures dominated by exotic species has dramatically declined invertebrate biodiversity within farmlands (Fountain and Wratten 2013). Approximately 25% of the remaining Indigenous vegetation cover in New Zealand is found on mixed livestock farms, primarily located in hill country areas (Fountain and Wratten 2013). These habitat fragments are crucial for biodiversity conservation, yet they face increasing strain due to intensive agricultural practices.

New Zealand's agricultural sector faces complex challenges, including environmental pressures, trade constraints, and increasing demands from overseas markets (Environment 2019; Pannell and Rogers 2022). These factors have created a pressing need for better regulation of pollution and emissions from agricultural activities.

Sustainable agricultural practices are increasingly recognised as essential for addressing environmental challenges such as climate change. Practices like regenerative agriculture and precision farming prioritising soil health, water conservation, and biodiversity preservation are becoming more prevalent (Verma *et al.* 2019; LandtoMarket 2022). However, the widespread adoption of these practices faces challenges, including technological barriers and economic constraints (Altieri 2018). Overcoming these barriers requires collaborative efforts among policymakers, researchers, industry stakeholders, and farmers. Sustainable practices like agroecology and regenerative agriculture are crucial for promoting ecological sustainability and economic viability (Beef&LambNZ 2021; Grelet *et al.* 2021).

Recognising the need for more sustainable practices, New Zealand farmers have increasingly shown significant interest in adopting regenerative agriculture practices, recognising their alignment with global trends favouring environmentally friendly food production (Grelet *et al.* 2021). This approach has gained momentum globally as it addresses the detrimental effects of conventional farming practices on the environment, livestock, and human health (Hes *et al.* 2018). Regenerative practitioners in New Zealand view this approach as beneficial for improving waterway health, preventing topsoil loss, and mitigating the impact of drought (Grelet *et al.* 2021). Furthermore, New Zealand producers can access premium overseas markets by embracing regenerative agriculture, as demonstrated by initiatives like the Savory Institute's Land to Market program (LandtoMarket 2022).

Government support for regenerative agriculture in New Zealand is evident through initiatives promoting efficient agrochemical and fertiliser use alongside other sustainable management practices. These efforts have reduced chemical inputs and greater production efficiencies (Brown *et al.* 2019). At the national level, the government has shown a solid commitment to transitioning the primary sector towards a regenerative mindset, as reflected in its vision and strategic plans (MPI 2017; MoE 2021a;2024c). This commitment is further underscored by New Zealand's ambitious goal to become carbon neutral by 2050 (Forbes *et al.* 2020).

In essence, regenerative farming seeks to restore degraded farmland to a biologically functional state while ensuring a sustainable income for those dependent on land resources (Wezel 2017a). Key outcomes include improved soil health, enhanced ecosystem services, better water quality, increased carbon sequestration, and improved well-being for livestock and farmers (Svec *et al.* 2012b; Wezel 2017a). Despite challenges such as decreased economic production, studies have shown that regenerative farming systems can achieve profitability and resilience through diversified enterprises (Fenster *et al.* 2021).

Regenerative farming aims to create synchronised and balanced systems that produce healthy and resilient outcomes, where the impact of production reinforces and stabilises the elements of that system through positive feedback loops (Krebs and Bach 2018). This requires a functional diversity of interconnected components, mirroring the complexity of natural ecosystems (Svec *et al.* 2012a). By aligning design intentions with observed patterns and outcomes, regenerative principles provide a framework for guiding actions and achieving predictable results (Geissdoerfer *et al.* 2016). To accomplish this in a farm context, Geissdoerfer *et al.* (2016) suggested examining the function of natural ecosystems and then identifying compatible agricultural species that can replicate those functions within a healthy agroecosystem. Fenster *et al.* (2021) suggest drawing inspiration from pioneers in regenerative farming and then applying design principles that have demonstrated successful results on the farm.

Systems thinking is central to regenerative farm design, emphasising the interconnectedness of elements within the system that are well adapted to perform well in that environmental context and beneficially integrate with the other elements in that system (Svec *et al.* 2012a; Novak *et al.* 2017). Regenerative farming systems aim to slow and dissipate energy, recycle matter effectively, and create outcomes more significant than the sum of individual parts through synergy (Regenerative

Agriculture Australia). This harmonious relationship between elements enhances resiliency, enabling systems to resist destabilisation and return to a steady state when disturbed.

5.1.1 Holistic Grazing

Holistic grazing, proposed by Savory and Butterfield (1998), has emerged as a focal point for regenerative grazing strategies (Massy 2017). It involves planned rotational grazing to mimic natural processes, fostering a positive feedback loop between pasture plants and soil organisms (Schutter and Dick 2002; Webster 2018). This approach aims to sequester carbon and retain soil water, potentially transforming grazing systems into carbon sinks (Machmuller *et al.* 2015; Johnson 2021).

Incorporating regenerative design principles into pastoral farming offers opportunities to improve soil health, conserve biodiversity, and enhance ecosystem resilience (Fenster *et al.* 2021). While outcomes vary and transition barriers exist, holistic grazing practices and silvopasture systems hold promise in New Zealand as '*first-step'* methods to progress current grazing (England *et al.* 2020; Howarth *et al.* 2022). Success requires tailored approaches considering site-specific conditions, farmer preferences, and broader policy frameworks supporting regenerative practices (Dhakal and Kattel 2019).

While holistic grazing has faced criticism for its perceived inefficiency and lack of evidence demonstrating superiority over conventional methods (Nordborg 2016), recent studies have highlighted its benefits (Xinghai *et al.* 2022). Ferguson *et al.* (2013) found significant differences between adopting holistic grazing management and higher soil respiration and deeper topsoil. Additionally, Wang *et al.* (2021b) emphasised the importance of managing stocking rates and implementing sustainable grazing strategies for long-term ecological and economic sustainability. Continued research and implementation of these practices are essential for addressing the challenges posed by livestock grazing and advancing agricultural sustainability (Wang *et al.* 2021a; Cao *et al.* 2024).

5.1.2 Silvopasture

Incorporating tree crops into pastures optimises land use efficiency while nurturing symbiotic relationships between animal and plant production systems (Jose & Dollinger, 2019; Mackay-Smith et al., 2022). Trees provide benefits like livestock shade, windbreaks, and additional income sources through timber, fruit, or nut production (Jose & Dollinger, 2019; Mackay-Smith et al., 2022). Moreover, their presence enriches soil health, promotes biodiversity, and sequesters carbon, fostering environmental sustainability (Jose and Dollinger 2019; Martin *et al.* 2019).

Silvopasture systems integrate trees and shrubs with livestock and pasture and provide diverse habitats, including shelter, nesting sites, and food resources for invertebrates, enhancing habitat quality within agricultural landscapes (Jose and Dollinger 2019). Furthermore, enhancing connectivity between habitat patches through landscape features such as hedgerows, field margins, and green corridors can facilitate species dispersal, allowing invertebrates to colonise new habitats and maintain gene flow between population (Jose and Dollinger 2019).

Transitioning New Zealand pastoral farms to silvopasture systems offers regenerative farmers a chance to diversify revenue streams and boost economic resilience (Mackay-Smith *et al.* 2021). The synergy between animal and plant systems in silvopasture production enhances financial resilience and diversity (Shrestha and Alavalapati 2004). Diverse income streams from livestock and tree crops buffer against market fluctuations and adverse weather events, mitigating overall risk for farmers (Shrestha and Alavalapati 2004). Furthermore, the array of products from silvopasture systems opens avenues for niche market penetration and premium pricing, bolstering farm profitability.

Trees provide benefits like livestock shade and additional income through timber or fruit production, enriching soil health and sequestering carbon (England *et al.* 2020). The flexibility of silvopasture allows farmers to tailor tree species to specific objectives and conditions, reducing synthetic fertiliser needs and production costs. This approach fosters financial resilience by diversifying income streams and mitigating risks from market fluctuations and adverse weather events, ultimately bolstering farm profitability.

The flexibility of silvopasture systems in crop selection allows farmers to tailor tree species to specific objectives and environmental conditions (Jose and Dollinger 2019; Mackay-Smith *et al.* 2022). Fast-growing species like poplar or willow yield quick returns through timber, while fruit or nut trees such as apples or chestnuts offer diverse revenue streams (Mackay-Smith *et al.* 2021). Nitrogen-fixing tree species enrich soil fertility, reducing synthetic fertiliser needs and production costs and enhancing economic resilience (Ye *et al.* 2023).

5.1.3 Climate Benefits

Regenerative farming systems, integrating holistic grazing and silvopasture practices, offer promising avenues for sequestering atmospheric carbon in New Zealand's grazing systems, thereby combating climate change (Ghosh and Mahanta 2014; Aryal *et al.* 2022). Various practices, such as soil sampling, baseline measurements, biomass and residue monitoring, grazing management, data collection, model utilisation, consideration of methane emissions, and periodic assessments can study the positive impact of adopting these practices (Technologies 2023; ZunoCarbon 2024).

Techniques like rotational grazing improve plant growth and root development, enhancing overall carbon sequestration (Wang *et al.* 2021a). Briske *et al.* (2008) describes how regenerative grazing practices promote healthier grasses and root systems, directly impacting carbon sequestration. Longevity in grazing management practices, as emphasised by Foley *et al.* (2011), is essential, considering potential decreases in carbon sequestration over time.

Regular data collection on forage production, livestock movements, and soil structure changes recommended by Lai and Kumar (2020), aids in assessing the impact of grazing practices, providing insights into dynamic interactions within the grazing system for continuous improvement. Allard *et al.* (2007) suggests using models and calculators tailored to estimate carbon sequestration to enhance management accuracy and the impact of methane emissions from livestock.

5.1.4 Regenerative Farming Conclusions

Exploring regenerative farming potential in New Zealand highlights the critical need for transitioning to practices that enhance soil health, biodiversity, and overall ecosystem resilience. New Zealand's global reputation for high-quality, sustainable agricultural products provides a strong foundation for this shift. The government's ambitious targets to reduce methane emissions and achieve net-zero greenhouse gases by 2050, alongside its strategic plans, underscore the commitment to this transition. Integrating regenerative practices such as holistic grazing and silvopasture addresses the environmental degradation of conventional farming and aligns with global market demands for eco-friendly products. By leveraging these regenerative practices, New Zealand can improve waterway health, prevent topsoil loss, and mitigate drought impacts, creating a sustainable agricultural sector supporting long-term environmental health, economic viability, and social well-being. This holistic approach, supported by robust government initiatives and market strategies, positions New Zealand's agricultural sector for a sustainable future.

5.2 A Regenerative Farming Enterprise

5.2.1 Resilience

Resilience is central to regenerative farming, and to operate sustainably, this must include a resilient approach to managing a farm profitably. In this context, resilience refers to the capacity of agricultural systems to absorb and recover from various challenges while maintaining essential functions and productivity. As highlighted by Sundstrom *et al.* (2023), this resilience underscores the critical need for agricultural systems to withstand and rebound from various challenges while maintaining essential operations and productivity. This resilience is pivotal in mitigating the effects of climate change, market volatility, and regulatory pressures, as emphasized by Darnhofer (2021). However, achieving resilience in farming necessitates strategic decision-making by farmers to anticipate, adapt to, and mitigate risks (Magesa *et al.* 2023). Hertel *et al.* (2021) highlights the value of diversification in income streams to reduce vulnerability to market fluctuations. Moreover, investments in technology and infrastructure, as advocated by Shang *et al.* (2021), play a pivotal role in enhancing the adaptive capacity of farming systems, enabling farmers to optimise resource use and mitigate environmental impacts.

5.2.2 Diversification

Integrating alternative farming models within established agricultural production systems, like share milking and Fonterra's milk distribution, represents an approach to increase farm diversity within productive systems with established supply chains and established market access (Pawson 2018). These ventures gain access to broader customer bases and lucrative export opportunities by leveraging existing networks and partnerships (Hooks *et al.* 2017; Liu *et al.* 2022). For example, Fonterra's milk distribution network can be integrated with Zespri's kiwifruit production. Fonterra, a significant player in New Zealand's dairy industry, has an extensive supply chain and distribution network for dairy products. Zespri, on the other hand, is renowned for its high-quality kiwifruit production and global market presence. Fonterra and Zespri could collaborate to explore opportunities to integrate dairy and kiwifruit production on shared farmland.

Under this integrated farming model, dairy pastures could be strategically interplanted with kiwifruit orchards, maximising land use efficiency and diversifying agricultural output. Fonterra's dairy farming and supply chain management expertise could complement Zespri's horticulture and fruit distribution knowledge. Together, they could conduct market research to identify consumer preferences and trends, ensuring that their integrated farming venture remains responsive to evolving market demands.

Furthermore, by leveraging Fonterra's existing distribution channels and Zespri's international market access, the integrated dairy-kiwifruit operation could access broader customer bases and lucrative export opportunities. This collaboration could result in a win-win situation, supporting steady income streams for dairy farmers and kiwifruit growers while promoting economic sustainability and agricultural diversity in New Zealand.

These models foster partnerships between landowners and aspiring farmers, opening opportunities for diversified agricultural ventures beyond dairy production and contributing to economic sustainability and agricultural diversity.

5.2.3 Brand Awareness

A market-oriented approach is indispensable for farm businesses seeking to respond to consumer demand effectively, navigate market trends, and remain competitive in dynamic environments. (Kahan 2003). This approach underscores the significance of market intelligence as a critical business strategy, enabling farmers to gather and analyse data on consumer preferences, industry trends, and competitor behaviour. Market intelligence dovetails with branding and is pivotal in market orientation by allowing farmers to differentiate their products, build brand equity, and establish strong connections with consumers. (Pujara 2016).

A well-defined brand identity communicates value, quality, and authenticity, empowering farmers to command premium prices and foster customer loyalty (Thiel 2014; Pujara 2016; Pawson 2018). Additionally, product differentiation emerges as another critical strategy involving the development of unique product attributes, features, or packaging to meet specific consumer needs or preferences. By offering differentiated products, farmers can create competitive advantages, mitigate price competition, and capture value in niche markets (Thiel 2014; Pujara 2016; Pawson 2018). By emphasising the environmental and social benefits of regenerative farming and leveraging New Zealand's pristine landscapes, farmers can position their products as premium offerings in high-value export markets, fostering sustainable growth and differentiation (Chin-Chun *et al.* 2008; Pawson 2018).

Moreover, value-added product development is crucial in enabling regenerative farmers to capture higher margins and differentiate their offerings in competitive markets (Beef&LambNZ 2020). By transforming raw materials into finished products with added value, such as organic dairy products or artisanal fruit preserves, farmers can command premium prices and mitigate price volatility risks. This diversification of product lines enhances the economic sustainability of regenerative practices and strengthens the resilience of farming operations against market fluctuations (Siegfried 2020).

5.2.4 Markets

Global market dynamics significantly influence New Zealand's export-dependent economy, shaping its trade policies, market access, and economic trajectory (Trade ; Online 2023). Geopolitical shifts, such as tensions between major global powers (S&PGobal 2024), can disrupt trade flows and subject New Zealand's exports, notably in agriculture and dairy, to tariffs (MFAT 2024b). Rising protectionism in critical markets presents formidable hurdles for exporters, requiring adaptive strategies to navigate uncertainties (WorldBank 2023).

Diversifying export markets beyond traditional partners is a pivotal strategy for mitigating reliance on any single market and spreading risk (Wang and Liu 2023). Strengthening trade agreements with strategic partners and addressing non-tariff barriers ensure equitable market access and facilitate trade facilitation (MFAT 2024a). Proactive measures aligned with this might include deepening economic bonds with like-minded trading partners and fostering a conducive trade environment for sustained export growth (MFAT 2024a).

5.2.5 Utilising AI Effectively

Artificial Intelligence (AI) holds immense potential to revolutionise sustainability efforts in the agricultural sector, particularly in New Zealand, where carbon credit accounting emerges as a prime example. Houston (2022) emphasises the pivotal role of technological advancements in facilitating direct-to-consumer marketing strategies, enabling farmers to leverage AI-driven tools for data collection, analysis, and targeted marketing campaigns. By tapping into digital platforms and e-commerce solutions, farmers can effectively reach conscious consumers who prioritise sustainability and ethical production practices.

At its core, AI empowers farmers to monitor, measure, and manage greenhouse gas emissions with unparalleled precision, efficiency, and reliability. Leveraging satellite imagery and geospatial data, AI algorithms can discern emission sources like methane and nitrous oxide across vast agricultural landscapes (Jongaramrungruang 2021). This high-resolution data enables accurate emissions estimation and identifies emission hotspots and trends, facilitating targeted interventions to reduce environmental impact.

Furthermore, AI excels in integrating diverse datasets from sensors, weather forecasts, and soil information, providing a comprehensive understanding of emission dynamics (Rayhan and Rayhan 2023). AI-enabled carbon credit accounting platforms automate data collection, analysis, and reporting tasks, simplifying the process and encouraging greater engagement in carbon offset programs (ZunoCarbon 2024). This fosters the adoption of sustainable practices and incentivises emission reduction efforts.AI enables customised strategies to mitigate emissions and enhance carbon sequestration by generating detailed emission profiles tailored to individual farms or regions (Minevich 2021). By automating routine tasks, AI frees up valuable resources for implementing sustainable farming practices. Real-time monitoring and feedback enhance efficiency by providing timely insights into emission trends and improvement opportunities.

5.3 Governance

New Zealand's governance structure, operating within a mixed-member proportional (MMP) system and grounded in democratic principles and power division, presents opportunities and challenges for sustainable farmland management, which has become a focal point of contemporary environmental advocacy (NZParliament 2021). The National Party's market-oriented governance prioritises economic growth, particularly in agriculture, sometimes at the expense of environmental concerns. At the same time, the Labour Party's interventionist approach emphasises social welfare and environmental protection (Schipper *et al.* 2014; George 2023; Palmer 2023; Wallace 2023). Despite New Zealand's governance system aiming to maintain checks and balances, the effectiveness of this system in addressing complex environmental challenges remains subject to debate (George 2023).

Transitioning governance within the Westminster System presents challenges, with limited advisory support for opposition parties potentially hindering informed decision-making (So 2016). Despite obstacles, ongoing challenges like freshwater degradation underscore the need for robust regulatory frameworks and collaborative solutions to ensure that policies have some longevity between MMP changes of government (MoE 2023c). Holley *et al.* (2020) highlighted some of the potential issues associated with changes in MP governance. Entrenched political interests and influence from influential industry players hinder the effectiveness of collaborative governance approaches, leading to inadequate protection of environmental resources.

Policy coherence and alignment across different levels of governance are critical for creating an enabling environment for sustainable farming practices (Glass and Newig 2019a). Integrated policy approaches that consider social, economic, and environmental dimensions are essential for addressing complex challenges such as climate change adaptation, water management, and biodiversity conservation (Rodney 2018; Glass and Newig 2019a; Glass and Newig 2019b; Wallace 2023). By integrating these principles into governance structures and policy frameworks, New Zealand can enhance its capacity to foster sustainable farmland management and advance environmental sustainability.

5.3.1 Regional Governance

Regional councils in New Zealand play a crucial role in managing local affairs and implementing national policies, particularly in environmental management (Botha *et al.* 2008; Rodney 2018). Sixteen regional councils and unitary authorities oversee land use planning, infrastructure development, and environmental stewardship, operating under Section 31 of the Resource Management Act (RMA) to manage water and environmental quality (EnvironmentFoundation 2018). Their primary function involves developing policies and regulations to protect water resources and maintain environmental standards, regulating water use, managing discharges, and enforcing ecological monitoring. Tailoring strategies to regional environmental conditions and community needs promotes sustainable resource use and ecological integrity (NZGovernment 2011).

However, regional councils face challenges like low voter turnout, averaging around 47% in 2019, which may hinder representative governance (NZGovernment 2022a). Increasing participation and engagement could enhance decision-making effectiveness and legitimacy. Furthermore, the evolving regional environmental governance landscape demands a shift toward partnership models prioritising collaboration (Fisher *et al.* 2022). Catchment groups representing rural communities' interests, are vital stakeholders in fostering this approach to collaborative bottom-up governance. However, their effectiveness relies on adequate funding and resources, highlighting the importance of regional council advocacy and resource allocation (Fisher *et al.* 2022).

5.3.2 Collaboration and Engagement

Effective outcomes in sustainable farming rely heavily on collaboration and stakeholder engagement across various sectors, including government, industry stakeholders, NGOs, and local communities (Velten *et al.* 2021). This collaborative approach is essential for addressing environmental challenges comprehensively. Insights from Batory and Svensson (2020) emphasise the importance of industry-led regulation and the collaboration between industry actors and government agencies to develop effective, mutually beneficial environmental policies. While promising, collaborative processes face risks due to competing interests, emphasising the need for sustained engagement and trust-building.

In New Zealand, initiatives like the Clean Streams Accord exemplify this collaborative spirit, bringing together various stakeholders to improve water quality, enhance biodiversity, and reduce greenhouse gas emissions. The Dairy Tomorrow Strategy and the He Waka Eke Noa framework are key examples of collaborative efforts supported by industry and government to ensure sustainable farming practices. These frameworks outline specific actions to mitigate environmental impacts while protecting New Zealand's natural heritage (DairyTomorrow 2022; Heyden 2023).

5.3.3 Advocacy

Advocacy within the Resource Management Act (RMA) context relies heavily on scientific evidence for credibility and effectiveness. Collaborative partnerships among government advisory groups, NGOs, and the private sector integrate scientific knowledge into policy formulation and implementation, emphasising transparency and communication for trust-building and shared environmental goals (Glass and Newig 2019b; Holley *et al.* 2020; Fisher *et al.* 2022). However, while scientific evidence is essential, it may sometimes be insufficient to address the complex socio-political dynamics of environmental policy formulation. This highlights the need for a more nuanced understanding of stakeholder interests and power dynamics within different advocacy groups (Morrison *et al.* 2020).

Some key advocacy groups involved in sustainable farmland management include Federated Farmers, who advocate for policies supporting agriculture and balancing economic and social well-being with environmental goals (TheCountry 2023). The Rural Advocacy Network addresses regulatory challenges and amplifies rural voices, aiming to represent rural communities' interests while fostering environmental sustainability (RAN 2024). Environment and Conservation Organizations of New Zealand (ECO) and Forest & Bird advocate for biodiversity conservation and sustainable land management, aligning closely with regenerative farm plans.

Māori land and Indigenous rights advocacy groups offer perspectives on integrating traditional knowledge into land management, ensuring cultural sensitivity and sustainability (MBIE 2020). Navigating New Zealand's agricultural landscape demands a delicate balance of stakeholder interests, from local communities and environmental groups to indigenous advocates and farming associations. It requires inclusive strategies that meld economic viability with ecological preservation and cultural sensitivity.

Navigating Māori issues demands a comprehensive approach considering socio-economic, environmental, and cultural dimensions. Integrating Māori values into water quality management strategies is crucial for ensuring the holistic well-being of ecosystems and communities (Johnston 2018). Māori concepts such as kaitiakitanga (guardianship) emphasise humans' responsibility to protect and care for the environment, including water bodies (JoanGoodall.Int.NZ 2024). This holistic approach considers not only water's physical health but also its spiritual and cultural dimensions, aligning with the principles of sustainability and intergenerational equity.

Community-based conservation groups complement top-down advocacy efforts, engaging communities in environmental stewardship (Guthrie 2020). Their grassroots approach bridges the gap between policy formulation and implementation, ensuring local communities' needs are represented. However, tensions may arise between grassroots initiatives and centralised governance structures, highlighting the importance of inclusive decision-making processes and the recognition of diverse perspectives (Simon-Kumar 2018).

Together, these advocacy groups form a diverse network contributing to farmland management in New Zealand. By collaborating with stakeholders, they shape policies promoting environmental sustainability and supporting farmers and rural communities, fostering a balance between economic prosperity, social well-being, and ecological conservation. However, ongoing challenges such as conflicting interests, power imbalances, and regulatory capture underscore the need to continuously evaluate and refine collaborative governance approaches to ensure effective and equitable outcomes for sustainable farmland management (Simon-Kumar 2018).

5.4 Policies

5.4.1 Resource Management Act

The Resource Management Act (RMA) has played a pivotal role in shaping New Zealand's environmental governance landscape. However, despite its intentions, the act has encountered significant challenges in implementation. One major hurdle lies in the complexity of compliance requirements and reporting obligations imposed on farmers (Allen 2019). Negotiating bureaucratic processes to obtain permits, monitor emissions, or meet reporting standards can be daunting, particularly for small-scale or resource-limited farmers (MoE 2021d). Consequently, this complexity often leads to inconsistent implementation, hindering full compliance with regulatory standards. Without robust support mechanisms, some farmers may struggle to embrace environmentally friendly measures or invest in emission reduction technologies, perpetuating environmental challenges (Piñeiro *et al.* 2020; ParlimentaryComissioner 2024).

Driven by mounting criticisms of the Resource Management Act (RMA), the New Zealand government has launched an ambitious reform agenda to address long-standing environmental governance deficiencies. The decision to phase out the RMA and introduce replacement legislation, including the Natural and Built Environment Act (NBA) and the Spatial Planning Act (SPA), reflects widespread concerns regarding the RMA's regulatory inefficiencies and prolonged decision-making processes (MoE 2024a).

The NBA aims to simplify and consolidate environmental laws, streamlining regulatory processes to facilitate more efficient decision-making and implementation of environmental policies. Conversely, the SPA heralds a fundamental shift by prioritising proactive spatial planning strategies. It anticipates future challenges and promotes coordinated development informed by diverse stakeholder perspectives and community aspirations (MoE 2024a; ParlimentaryComissioner 2024).

However, these legislative changes are not without contention. While proponents argue that the NBA will enhance clarity and reduce bureaucratic hurdles, critics raise concerns about potential trade-offs between efficiency and environmental protection (Allen 2019; MoE 2021d). Similarly, while the SPA advocates for proactive planning, questions linger regarding its feasibility and potential conflicts between development interests and environmental priorities (ParlimentaryComissioner 2024).

The success of these legislative initiatives hinges critically on robust collaboration between central and local government entities. Effective communication channels, shared objectives, and mutual understanding are essential for overcoming jurisdictional complexities and ensuring seamless implementation (MoE 2020b). Furthermore, meaningful engagement with communities and stakeholders is paramount to solicit input, address concerns, and foster ownership of the planning process (TheCountry 2023; ParlimentaryComissioner 2024). Only through inclusive and transparent decision-making can these reforms fulfil their overarching objectives of advancing sustainable development and environmental resilience (MoE 2021c).

5.4.2 Environmental Reporting Act

The Environmental Reporting Act 2015 bestows discretionary authority upon the Parliamentary Commissioner for the Environment to assess environmental reports and the processes involved in their creation (MoE 2021b). While this authority is not explicitly outlined in the Act, it stems from the broad terms of the Environment Act 1986, which established the Commissioner's role. However, despite the Act's intent to streamline environmental reporting, New Zealand's reporting system has evolved organically, often utilising existing data and knowledge gathered for unrelated purposes.

Upon the release of Environment Aotearoa 2019 (MoE 2019), the Commissioner commended the report for its focused approach to addressing priority environmental issues. Nevertheless, a comprehensive review ensued, revealing significant gaps in ecological knowledge resulting from decades of unplanned decision-making (Environment 2019). The review identified the reporting system's passive and opportunistic nature, relying on available data without actively seeking to fill knowledge gaps (Environment 2019).

Proposed amendments to the Act aim to refine its purpose and structure, addressing the identified shortcomings (MoE 2022). Recommendations include establishing a more explicit purpose, extending reporting intervals, and expanding the reporting framework to encompass drivers and outlooks. Additionally, the review emphasises the importance of prioritising and gathering data consistently to detect trends accurately (MoE 2022).

5.4.3 Zero Carbon Act

The Zero Carbon Act is significant legislation in New Zealand's effort to combat climate change. It brings both opportunities and challenges for sustainable farming (MoE 2020a). The Zero Carbon Act sets ambitious targets for reducing emissions and outlines policies to mitigate climate change. However, translating the goals of the Zero Carbon Act into practical actions for farmers presents several difficulties (Smith 2015; MoE 2022). Compliance and reporting requirements create significant bureaucratic burdens, diverting time and resources from farming activities (Brandt *et al.* 2013). Small-scale or resource-constrained farmers face disparities in access to financial resources, technology, and support, which impede their ability to adopt eco-friendly practices effectively (PWC 2023).

Practical implementation gaps are evident, with farmers struggling to translate broad legislative directives into specific, actionable steps suitable for their unique operations (Journeaux 2020). Continuous government support, including training, resources, and incentives for sustainable practices, is essential (MoE 2024b). Moreover, while the Act emphasises community engagement, the effectiveness and inclusivity of these efforts vary, posing challenges in ensuring that all stakeholders, particularly farmers and Indigenous groups, are adequately represented and their needs addressed (MacLeod *et al.* 2022). Additionally, the Climate Change Commission's role in monitoring progress and providing guidance is crucial. However, concerns remain about its effectiveness in bridging the gap between policy formulation and real-world application.

A recent study by AgFirst investigated potential approaches farmers could take to meet the expectations of the Zero Carbon Act (Journeaux 2020). To address nutrient losses and mitigate greenhouse gas (GHG) emissions in sheep and beef farming. Afforestation emerges as a potent strategy for reducing nitrogen and phosphorus losses. Calculations of "carbon shadow prices" underscore the economic viability of mitigation measures relative to emission reductions. Adjusting farm systems, such as balancing stocking rates and productivity, is crucial for achieving methane reduction targets while maintaining profitability. Afforestation offers a viable option for GHG offsetting, especially for sheep and beef farms. However, its short-term nature necessitates long-term planning for sustained reductions.

5.4.4 New Zealand Emissions Trading Scheme

Another aspect of driving zero carbon emissions is the New Zealand Emissions Trading Scheme (NZ ETS). While the NZ ETS aims to put a price on greenhouse gas emissions and drive sustainability across industries, its impact on agricultural emissions has been modest (ICCC 2019). The scheme acknowledges agriculture as a significant source of emissions, contributing about 50% of New Zealand's gross emissions, predominantly from biogenic methane and nitrous oxide (ICCC 2019). However, the mechanisms of carbon sequestration and trading within the NZ ETS have not resulted in substantial emission reductions in this sector (ICCC 2019).

One challenge is that the NZ ETS's market-driven approach may unfairly burden small-scale farmers and widen socio-economic disparities (Leining 2016). The complexity of trading and compliance requirements can deter smaller operators from participating effectively, making it difficult for them to benefit from the scheme. Additionally, while the NZ ETS incentivises emission-reducing practices, its current structure may favour incremental improvements over transformative innovations, limiting the overall potential for significant emission reductions and climate resilience in agriculture (Leining 2016).

Furthermore, integrating the NZ ETS with other agricultural policies may not fully address sector-wide challenges. Fragmented policy implementation can lead to disjointed efforts, hindering the synergy between emission reduction, soil health, water quality, and biodiversity conservation initiatives. Continuous refinement and alignment with comprehensive agricultural and environmental policies are essential to make the NZ ETS more effective.

The New Zealand government has proposed a comprehensive plan to address the shortcomings of the Emissions Trading Scheme (NZ ETS) by introducing farm-level emissions pricing (NZGovernment 2022b). This initiative aims to position New Zealand farmers as global leaders in reducing agricultural emissions, meeting the Zero Carbon Act's 2030 methane reduction targets, and enhancing export competitiveness (NZGovernment 2022b). The proposal involves reinvesting revenue into the agriculture sector through new technology, research, and incentives. Extensive consultations will refine sequestration methods, levy settings, and transition support.

5.5 Measuring Farm Biological Health

5.5.1 Water Quality

Natural resource management in New Zealand places a paramount emphasis on preserving water quality to protect its freshwater ecosystems from agricultural pollution, as described in the National Policy Statement for Freshwater Management (MoE 2023d). This policy targets critical issues such as nutrient pollution, sedimentation, and microbial contamination from agricultural runoff. Regional councils are then entrusted with the primary responsibility for water quality regulations (MoE 2023c).

In line with this policy, the government has devised a freshwater management strategy anchored by the National Policy Statement (MoE 2024c), aiming to bridge the widening gap between regulatory aspirations and environmental realities. The strategy seeks to align regulatory frameworks with tangible environmental outcomes by halting declines in water quality and advocating sustainable farming practices via freshwater farm plans.

Research highlights the complex interactions between farming activities and water quality. Agricultural runoff, particularly from intensive dairy farming, poses significant threats (Quinn *et al.* 2009). Nutrient runoff can lead to eutrophication and algal blooms, while sedimentation from soil erosion can degrade water clarity and aquatic habitat quality (Chislock 2013).

Efforts to address the impact of farming practices on freshwater quality require a multifaceted approach that encompasses environmental considerations, cultural values, and sustainability imperatives (MoE 2024c). In New Zealand, where freshwater holds immense cultural significance for Māori communities, integrating Indigenous perspectives and values into water quality management is essential (Cole *et al.* 2013; Grelet *et al.* 2021). This integration recognises the interconnectedness of land, water, and cultural identity, underscoring the need for holistic environmental stewardship (MoE 2023c).

Implementing on-farm measures is crucial for mitigating the impact of farming on water quality in New Zealand. Studies by Majumdar and Avishek (2023) and Cole *et al.* (2020) shed light on specific practices that effectively reduce contaminant runoff into waterways. Riparian planting emerges as a critical strategy, involving the establishment of vegetated buffer zones along watercourses to trap sediment and filter nutrients before they reach water bodies. Additionally, erosion control measures such as contour planting and terracing can help prevent soil erosion and reduce sediment transport into streams and rivers (Khose *et al.* 2023).

Nutrient management plays a crucial role in minimising nutrient runoff from agricultural land. Implementing precision farming techniques, such as variable rate fertilisation and controlled release fertilisers, can optimise nutrient application and reduce excess nutrient leaching into waterways (Khose *et al.* 2023). Furthermore, improving farm waste management practices can significantly reduce the release of pollutants into water bodies (Wezel *et al.* 2013). Proper storage and disposal of animal waste and adopting technologies like anaerobic digesters for manure treatment can help prevent nutrient runoff and microbial pollution (Wezel 2017a; Khoshnevisan *et al.* 2021).

Assessing water quality parameters such as nutrient levels, sedimentation, and pesticide residues in water bodies adjacent to farmlands is crucial for understanding the impact of agricultural activities on aquatic ecosystems (MoE 2019). Long-term monitoring of water quality changes provides valuable insights into the effectiveness of regenerative farming practices in mitigating runoff and pollution.

5.5.2 Biodiversity

Intensive agricultural activities, such as grazing and land clearance for pasture expansion, exert immense pressure on these habitat fragments, resulting in habitat degradation and fragmentation (Fountain and Wratten 2013). Consequently, invertebrate populations crucial for ecosystem functioning and stability are experiencing a decline within these fragmented habitats (Fountain and Wratten 2013).

Landscape management strategies prioritising conservation and restoration efforts are imperative to address the decline in invertebrate biodiversity and promote ecological restoration within farmlands (Jose and Dollinger 2019). Designing landscapes that accommodate diverse vegetation structures, including native plant species, shrubs, and trees, can provide essential resources such as food, shelter, and breeding sites for sustaining invertebrate populations (Jose and Dollinger 2019).

By prioritising the conservation of indigenous vegetation remnants within agricultural landscapes and implementing sustainable land management practices, the loss of invertebrate biodiversity can be mitigated, and the ecological resilience of New Zealand's pastoral farms can be promoted. Adopting farming methods that integrate habitat refuges and enhance landscape connectivity is imperative to address these challenges (Grass *et al.* 2019).

The New Zealand Biodiversity Strategy, established in 1998, outlines strategic objectives for conserving and rehabilitating native ecosystems and species diversity. It focuses on safeguarding habitats, facilitating restoration, and encouraging sustainable land management practices (DoC 2000). Key initiatives under the strategy include establishing protected areas, enhancing ecosystem services, and promoting biodiversity-friendly farming practices. Agri-environmental schemes, such as the QEII National Trust Open Space Covenant, incentivise landowners to set aside land for conservation, creating wildlife corridors and buffer zones within agricultural landscapes (England *et al.* 2020).

However, these measures focus only on recognising significant habitats, neglecting biodiversity within these habitats. This limited approach hampers understanding of overall biodiversity status and conservation needs across agricultural landscapes, hindering practical conservation efforts (England *et al.* 2020). There is an urgent need for more comprehensive policies that prioritise biodiversity alongside water quality management and soil health, recognising their interconnectedness in maintaining farm ecological health and environmental sustainability (Willis 2016).

Biodiversity management on farmed landscapes faces persistent challenges, including a continual decline in biodiversity, complex causes, lack of coordination among agencies, and fragmented legislation that hinders effective conservation (Willis 2016). However, opportunities exist for change, such as community initiatives and technological advancements.

The concept of biodiversity credits in New Zealand is gaining traction as a potential incentive to bolster conservation efforts (MoE 2023e). With many native species at risk of extinction and critical habitats situated outside conservation areas, there is a recognised shortfall in current investment in biodiversity protection (Ewing 2024). Biodiversity credit systems offer individuals and companies a mechanism for investing in projects to safeguard, restore, and enhance native wildlife and ecosystems (MoE 2023e). These projects could encompass a range of activities, including forest protection, wetland restoration, native tree planting, and the creation of buffer zones near protected habitats.

The Ministry for the Environment and the Department of Conservation have initiated consultations to gather public feedback on establishing a biodiversity credit system (MoE 2023e). Key considerations include instilling trust in biodiversity credits and defining the government's role in the system. This feedback will inform the government's recommendations on the credit system's design and implementation, ensuring that it effectively supports conservation endeavours while addressing the pressing challenges facing New Zealand's biodiversity.

5.5.3 Soil Health

The soils in New Zealand, which initially supported good pasture growth (due to the nutrient supply from clearing and burning the forest), were rapidly depleted (Newnham *et al.* 2018). This was due, in part, to the high levels of soil erosion caused by the removal of forests that stabilised soils, combined with the high rainfall on often rolling farmland terrain (Perry *et al.* 2014). Other factors were the destruction of the existing ecosystems, with their soil-building and nutrient-recycling organisms (Terashima and Mihara 2021). Gibbs (1980) describes the characteristic tendency of NZ soils to have shallow topsoil and deep clay-based subsoil, which means these soils quickly lose productivity when erosion occurs. This shallow topsoil was particularly prone to erosion once the protective forest cover was removed (Donovan 2022).

In New Zealand, soil erosion remains a pressing issue, with millions of tons of soil lost to the sea annually (Gibbs 1980; Haggerty and Campbell 2008). This loss, exacerbated by soil depletion from land clearance and over-grazing, poses significant economic and environmental challenges. (Dominati and Mackay 2013; Churchman and Velde 2019). Moreover, soil compaction and degradation of soil structure are prevalent issues in pastoral agricultural systems, impacting water infiltration and root penetration (Lopez and Kemp 2016; Donovan 2022). Loss of soil biodiversity and microbial activity further exacerbates soil health problems, particularly in regions dominated by intensive farming (Li *et al.* 2018; Lehmann *et al.* 2020). The intensification of agricultural activities has further accelerated soil degradation, particularly in regions with high agrarian intensity (MoE 2019).

Despite soil's vital role in New Zealand's economy and environment, soil health has not received the same attention as other environmental concerns, such as water quality. This is evident in the limited progress and attention given to soil management since the release of the 2015 MPI report (MPI 2015). The report highlighted the critical need to address soil-related challenges, emphasising the importance of safeguarding versatile soils and implementing coordinated land management practices. However, there has been a notable lack of substantial advancements or policy changes in soil management initiatives since then. Despite global recognition of the importance of soil health and initiatives such as the United Nations Global Soil Partnership, New Zealand's soil resources continue to face increasing pressures without commensurate attention or action. This lack of progress underscores the urgency for enhanced focus and investment in soil management policies and practices to ensure the long-term sustainability of New Zealand's primary industries and ecosystems.

In response to these challenges, various measures have been proposed and implemented to conserve soil health in New Zealand. These initiatives include promoting sustainable land management practices, such as erosion control measures, afforestation programs, and riparian planting along waterways to reduce soil erosion and sedimentation. Additionally, efforts have been made to promote regenerative agriculture practices that focus on building soil health through practices like reduced tillage, cover cropping, and crop rotation, enhancing soil structure, fertility, and biological activity (MPI 2015).

Furthermore, raising awareness among farmers and stakeholders about the importance of soil conservation and management through educational programs, workshops, and extension services has been prioritized. Despite these efforts, greater investment and policy support remain needed to address the ongoing challenges facing New Zealand's soil resources and ensure their long-term sustainability.

There is a pressing need for quantitative soil health assessments to support sustainable agricultural management (Dennis *et al.* 2012). Historically, scientists have been hesitant to embrace the concept of ‘soil health’ due to challenges in defining it with universally quantifiable measures (Lobry de Bruyn 1997; Lehmann *et al.* 2020). Lehmann *et al.* (2020) suggests using multiple indicators to provide a robust assessment framework. Suitable metrics include spider diversity, earthworm abundance, soil aggregate sizes, soil carbon levels, pasture diversity, pasture Brix levels, soil nutrients, and habitat diversity. This framework allows tracking progress and making data-driven improvements while demonstrating sustainable agriculture benefits to consumers and stakeholders (McGeoch *et al.* 2002; Pearce and Venier 2006). Accurate measurements and positive impacts support accreditation and participation in initiatives like New Zealand's Emissions Trading Scheme and the Carbon Farming Initiative, providing financial incentives for regenerative farming practices (Forbes *et al.* 2020).

A recent study (Pedley 2023) The study used a similar suite of soil health indicators to investigate differences between farms adopting holistic grazing and conventional grazing practices. However, the study found insufficient evidence to distinguish between these practices, potentially due to a lack of habitat diversity needed to support a greater variety of invertebrates.

Pearce and Venier (2006) describe monitoring a few indicator species as a practical method for assessing land management sustainability. McGeoch *et al.* (2002) proposed that generalist species would be more effective indicators of ecological change than specialists, as they reflect general habitat changes and are more abundant in modified farmlands. Biological indicators provide valuable insights into ecosystem function and soil health dynamics (Pearce and Venier 2006), although practical application and implementation remain challenging (Lobry de Bruyn 1997). McGeoch *et al.* (2002) suggests that species with a more generalist habitat preference (such as spiders and *Carabidae* beetles) would be more effective as indicator species of ecological change than more specialised species with more sensitive habitat requirements because they act as indicators of general habitat changes rather than indicating loss of specific specialist niches. It is also more likely that these detector species are more abundant in modified farmland and, therefore, are more valuable as bioindicators within this context (McGeogh 1998; McGeoch *et al.* 2002).

Long-term monitoring and experimental studies are crucial for understanding the relationships between farming practices, invertebrate communities, and soil health (Stokes *et al.* 2021). A multidisciplinary approach integrating soil health, water quality, biodiversity, and productivity assessments promotes sustainable agriculture, enabling informed decisions to optimize resource management and enhance agricultural system resilience (Pannell and Rogers 2022).

5.5.4 Freshwater Farm Plans

Freshwater resources are critical to New Zealand's environmental and economic sustainability, making their management and conservation essential. The development and implementation of Freshwater Farm Plans (FWFPs) have emerged as a significant approach to addressing the environmental risks associated with farming activities (MoE 2023a). These plans are designed to promote sustainable farming practices while upholding ecological regulations, thereby preserving and enhancing freshwater ecosystems across the country.

These plans are proactive strategies to manage and mitigate potential adverse impacts from farming practices on water quality and associated cultural values (McClay 2024). Developed in alignment with regulatory frameworks such as the Resource Management Act and National Environmental Standards for Freshwater, FWFPs integrate Good Management Practices (GMPs) to identify, assess, and manage risks effectively. They offer detailed guidelines for farmers to map their land units, evaluate inherent vulnerabilities, and implement tailored actions to mitigate risks. FWFPs ensure compliance with statutory requirements and industry standards through auditing processes that aim to foster sustainable farming practices that safeguard freshwater resources (Anonymous. 2023).

Through the development and implementation of action plans within FWFPs, farmers are encouraged to adopt innovative strategies and technologies to enhance sustainability outcomes.

However, persistent concerns regarding the bureaucratic nature of freshwater farm plans underscore the necessity for effective implementation mechanisms to ensure their efficacy (Williams 2023).

The Ministry for the Environment's report on the Ōtūwharekai/Ashburton Lakes in Canterbury (MoE 2023b) Accentuates systemic deficiencies within existing freshwater management approaches. Despite implementing various plans and frameworks, including the Essential Freshwater Initiative, nutrient runoff from nearby pastoral farms continues to degrade water quality in these lakes (MacLeod *et al.* 2022). This disconnect between regulatory intent and environmental outcomes underscores the urgent need for more effective tools and strategies to mitigate nutrient losses and safeguard freshwater ecosystems. Furthermore, the report identifies fragmented decision-making and regulatory capture as significant challenges in current freshwater management paradigms. The decentralisation of decision-making authority to farmers and their advisors raises concerns about prioritising short-term economic interests over long-term environmental sustainability (Williams 2023). Without robust oversight and accountability mechanisms, there is a heightened risk of regulatory capture, undermining the effectiveness of measures intended to protect freshwater ecosystems (McClay 2024).

Opposition from agricultural groups to freshwater farm plans highlights the complexities of implementing regulatory frameworks that balance environmental concerns with stakeholder acceptance (Williams 2024). These plans are criticised for their bureaucratic complexity and associated costs, potentially hindering farmers' widespread adoption (Joy 2021; Williams 2024). Moreover, the plans' lack of flexibility to accommodate diverse farming practices and environmental conditions across regions exacerbates the challenge of achieving meaningful improvements in freshwater management outcomes (Williams 2024).

5.6 PESTEL Analysis: Summary of Insights from the Literature Review

This PESTEL analysis synthesises key insights from the literature review to address the study's aim of enhancing Freshwater Farm Plan (FWFP) reports by developing regenerative farm blueprints. These blueprints integrate legislative frameworks, regenerative design principles, and strategic business approaches tailored to small to medium-sized agricultural enterprises. The analysis examines Political, Economic, Social, Technological, Environmental, and Legal factors that impact the implementation of sustainable farming practices. By providing a comprehensive understanding of these factors, the analysis helps formulate practical guidelines to refine FWFPs, creating resilient agricultural systems that improve soil health, optimize water management, and promote biodiversity conservation, ensuring long-term sustainability and productivity in New Zealand's agricultural sector.

5.6.1 Political

The integration of legislative frameworks is critical for the development of regenerative farm blueprints. The National Policy Statement for Freshwater Management and the Resource Management Act (RMA) are fundamental in establishing water quality and environmental regulations in New Zealand. These frameworks provide the legal basis for managing nutrient pollution, sedimentation, and habitat degradation caused by agricultural activities. Recent legislative reforms, including the Natural and Built Environment Act (NBA) and the Spatial Planning Act (SPA), aim to streamline regulatory processes, making it easier for farmers to comply with environmental regulations while promoting sustainable development.

These legislative changes reflect the government's commitment to addressing complex environmental challenges and improving regulatory efficiency. The NBA and SPA are designed to reduce bureaucratic hurdles and facilitate coordinated development informed by diverse stakeholder perspectives. By aligning FWFPs with these legislative frameworks, the regenerative farm blueprints can ensure compliance with statutory requirements, promoting sustainable farming practices that protect freshwater resources and support long-term environmental sustainability. Government initiatives such as the Emissions Reduction Plan, which includes measures to assist farmers in reducing emissions and developing climate mitigation technologies, further emphasize the role of policy in supporting the transition to sustainable agricultural practices.

5.6.2 Economic

Financial barriers are a significant challenge for implementing regenerative practices, especially for small to medium-sized agricultural enterprises. The costs associated with transitioning to regenerative farming methods, such as adopting precision nutrient management and investing in advanced technologies, can be substantial. However, financial support and incentives from government programs can alleviate these burdens. Diversification strategies, such as integrating silvopasture and holistic grazing, can help stabilise income streams, reduce vulnerability to market fluctuations, and enhance financial resilience.

Accessing export markets and securing premium pricing for sustainably produced agricultural products can further enhance economic viability. New Zealand's reputation for high-quality agricultural products positions it favourably in discerning international markets. By leveraging this reputation and adopting regenerative practices, farmers can tap into niche markets that prioritize sustainability, increasing their profitability and supporting the economic sustainability of their operations. Businesses integrating eco-friendly initiatives also gain a competitive edge by meeting consumer expectations and regulatory standards.

5.6.3 Social

Effective stakeholder engagement and collaboration are essential for the successful implementation of sustainable farming practices. Diverse stakeholders, including government agencies, industry stakeholders, NGOs, local communities, and Māori groups, are involved to ensure that various perspectives are considered and respected. Integrating Māori values and community-based conservation efforts promotes holistic environmental stewardship, recognizing the interconnectedness of land, water, and cultural identity.

Education and training programs are crucial for raising awareness and equipping farmers with the knowledge and skills to implement regenerative practices effectively. Workshops, extension services, and educational initiatives can help farmers understand the benefits of sustainable practices and how to integrate them into their operations. By fostering a culture of sustainability and collaboration, regenerative farm blueprints can facilitate the widespread adoption of practices that improve environmental outcomes and support community well-being. Broader participation in learning processes and transparent feedback mechanisms are key to ensuring effective management and stakeholder acceptance.

5.6.4 Technological

Technological innovation and infrastructure development are vital for optimizing resource use and improving environmental outcomes. Investments in advanced technologies, such as AI-driven tools for emissions monitoring and precision farming techniques, can significantly enhance the efficiency and effectiveness of sustainable farming practices. AI facilitates precise monitoring of greenhouse gas emissions, efficient resource management, and targeted marketing strategies, enabling farmers to make data-driven decisions that improve sustainability.

AI-driven platforms also simplify carbon credit accounting and support the adoption of sustainable practices by automating data collection, analysis, and reporting tasks. These technologies can help farmers monitor and manage their environmental impact more effectively, providing real-time insights into emission trends and opportunities for improvement. By leveraging technological advancements, regenerative farm blueprints can drive innovation and enhance the environmental performance of agricultural systems. Investments in technology and infrastructure play a pivotal role in enhancing the adaptive capacity of farming systems, enabling farmers to optimize resource use and mitigate environmental impacts.

5.6.5 Environmental

Environmental considerations are central to the development of regenerative farm blueprints. Implementing practices such as riparian planting, erosion control, and precision nutrient management is essential for protecting freshwater ecosystems from agricultural runoff. Long-term monitoring of water quality provides valuable insights into the effectiveness of these practices in mitigating pollution and preserving aquatic habitats. By adopting these measures, farmers can significantly reduce their environmental impact and contribute to the sustainability of freshwater resources.

Biodiversity conservation is another critical aspect, with landscape management strategies that include diverse vegetation and habitat restoration being crucial for enhancing ecological resilience. Initiatives like biodiversity credits can incentivize conservation efforts and support the restoration of native ecosystems. Sustainable land management practices, such as reduced tillage, cover cropping, holistic grazing, and silvopasture, improve soil structure and fertility, addressing soil erosion and compaction issues. By focusing on these environmental factors, regenerative farm blueprints can promote the health and sustainability of agricultural ecosystems. Comprehensive policies that prioritize biodiversity alongside water quality management and soil health are essential for maintaining farm ecological health and environmental sustainability.

5.6.6 Legal

Legal compliance and regulation are essential for ensuring that regenerative farm blueprints align with existing environmental laws and standards. Streamlining the implementation of FWFPs and reducing bureaucratic complexity can enhance farmer adoption and compliance. Adhering to certification standards for sustainable farming practices can improve marketability and consumer trust, providing farmers with a competitive edge in the market.

Continuous refinement of policies, such as the Zero Carbon Act and the New Zealand Emissions Trading Scheme (NZ ETS), supports scalable emission reduction strategies and provides financial incentives for sustainable practices. These policies aim to reduce greenhouse gas emissions and promote sustainable farming practices, aligning with New Zealand's broader environmental goals. By ensuring robust legal frameworks and clear regulatory guidelines, regenerative farm blueprints can facilitate the transition to sustainable farming practices and contribute to long-term environmental sustainability. Effective governance requires policy coherence and alignment across various levels, ensuring that economic, social, and environmental dimensions are integrated into the decision-making process.

6 Methodology

6.1 Survey Design and Objective

The literature review identified key areas critical to developing regenerative farm blueprints. These areas informed the creation of a survey comprising 22 long-answer questions (see Appendix 1). The questions aimed to gather insights from participants on these key topics, facilitating the triangulation of knowledge between on-the-ground farming professionals and existing literature. This approach enabled a SWOT analysis of critical issues relevant to developing the Regenerative Farming Blueprint.

Key Topics

The survey focused on several essential topics: business strategy, regenerative design, sustainability legislation, governance, and farm health. The resulting blueprints were designed to enhance traditional Freshwater Farm Plans (FWFPs) by providing comprehensive guidance for farmers transitioning to regenerative practices. These plans aim to thoroughly evaluate environmental impacts, tailor practices to individual farmers' strengths, and seize market opportunities, ensuring relevance across various farming contexts.

Survey Structure

The survey was structured to gather insights on critical aspects of sustainable farming practices, divided into seven sections, each focusing on a specific aspect:

1. **Regenerative Design Principles**: This section aimed to understand participants' definitions of regenerative design in agriculture, practical implementation strategies, associated benefits, and challenges.
2. **Freshwater Farm Plans (FWFPs)**: Questions examined the key components and objectives of FWFPs, the integration of regenerative principles, and perceived implementation barriers.
3. **Business Strategies in Sustainable Farming**: This section explored the types of business strategies commonly adopted by sustainable farms, their influence on sustainability outcomes, and the relationship between them and farming practices.
4. **Soil Health Management**: Participants were asked about the importance of soil health, practical techniques for its improvement, and common challenges faced in maintaining soil health on farms.
5. **Water Management Strategies**: This section investigated the role of water management in sustainability, observed or implemented strategies, and challenges and successes in integrating these strategies into sustainable farming practices.

6. **Biodiversity Conservation**: Questions focused on the role of biodiversity conservation in farming, strategies to enhance biodiversity, and challenges encountered in implementing these strategies.
7. **Legislative Frameworks**: This section assessed participants' familiarity with sustainability legislation in New Zealand, the impact of specific legislative provisions on farm design practices, and compliance challenges agricultural businesses face.

Participant Instructions

Participants were provided with an introduction and consent form outlining the study's purpose, their rights, and the confidentiality measures. Participation was voluntary, and responses were assured that they would be anonymised and kept confidential. The survey was designed to take approximately 40-50 minutes to complete, aiming to gather in-depth insights from a diverse range of stakeholders.

6.2 Data Analysis

Thematic analysis was used to analyse the qualitative data collected from the survey, systematically identifying and categorising key themes and concepts from the responses. This method followed Braun and Clarke's (2006) six-phase guide, ensuring a thorough and structured examination of the data.

Six-Phase Guide to Thematic Analysis

1. **Familiarization with Data**: The process began with multiple readings of the survey responses to gain a deep understanding of the content.
2. **Generating Initial Codes**: Initial codes were created by identifying significant features of the data and tagging phrases or concepts that represented the essence of the responses.
3. **Searching for Themes**: The initial codes were then sorted into potential themes, grouping related codes to capture the main ideas within the data.
4. **Reviewing Themes**: The identified themes were reviewed for coherence and accuracy, ensuring they meaningfully and distinctly represented the data.
5. **Defining and Naming Themes**: Each theme was refined and given a concise, descriptive name that reflected its key ideas.
6. **Producing the Report**: The final phase involved writing a detailed report that illustrated the identified themes with supporting data extracts and provided an interpretation of the findings with supporting graphs to illustrate the thematic analysis themes and trends.

Thematic analysis was used to analyse the qualitative data collected from the survey. This approach systematically identified and categorised key themes and concepts from the responses. The thematic analysis to identify key themes from survey responses was performed using ChatGPT-4o, with the results shown in Appendix 2. This analysis identified the most common critical concepts in response to each survey question and their frequency of occurrence in the responses, with the number of key themes varying across different sections.

ChatGPT-4 was employed in this analysis, and the AI software effectively identified critical concepts in the survey responses and their frequency of occurrence. The effectiveness of ChatGPT-4o in performing thematic analysis was validated by cross-checking the AI-generated themes against manually identified themes within responses to two sample questions. This comparison showed a high level of agreement between the AI-generated and manually identified themes, supporting the reliability of ChatGPT-4o in thematic analysis.

Recent scientific literature supports using AI tools like ChatGPT for qualitative data analysis. Studies have demonstrated that AI can efficiently process large datasets, identify patterns, and generate insights with accuracy comparable to traditional methods. For instance, research published in the Journal of Qualitative Research highlights the growing adoption of AI for thematic analysis in various fields, citing improved efficiency and consistency in identifying themes (Smith et al., 2023). Additionally, a case study in the International Journal of Social Research illustrates the successful application of AI-driven thematic analysis in educational research, further endorsing its utility (Brown & Green, 2024).

6.3 SWOT Analysis

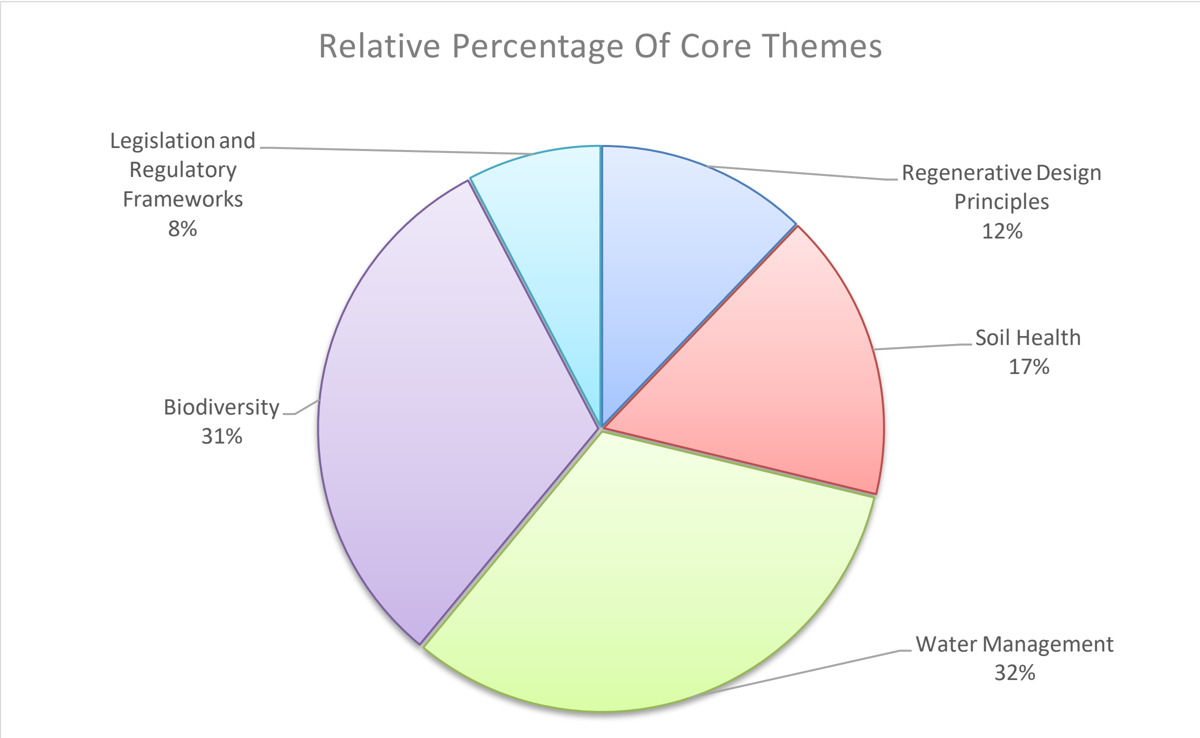
A SWOT analysis was conducted by integrating insights from the literature review and the thematic analysis of survey responses to assess the development of regenerative farm plans. This analysis examined the internal strengths and weaknesses and the external opportunities and threats associated with implementing regenerative farming practices. Key focus areas included the integration of regenerative design principles, business strategies, soil health management, water management strategies, and biodiversity conservation efforts. This comprehensive evaluation provided a strategic framework to guide stakeholders in leveraging resources effectively, fostering innovation, and addressing critical challenges to enhance sustainability outcomes in pastoral agriculture.

7 Results

7.1 Core Themes in Sustainable Farming Practices

The survey results highlighted several key themes related to sustainable farming practices and environmental stewardship. The core themes identified include Regenerative Design Principles, Soil Health, Water Management, Biodiversity, and Legislation and Regulatory Frameworks. Figure 1 illustrates the distribution of these core themes as percentages of the total mentions. This visual representation underscores the relative importance of each theme, providing a clear overview of the focus areas among the participants.

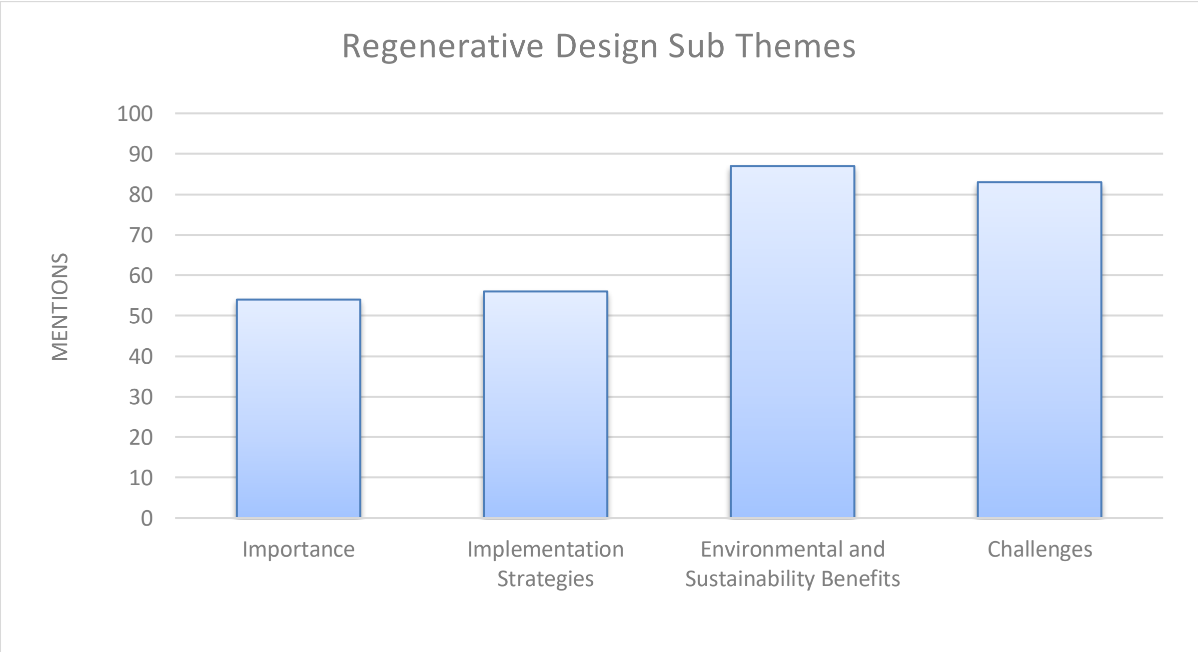
Figure 1: Relative Distribution of Core Themes in Sustainable Farming Practices



7.2 Regenerative Design Principles

The theme of Regenerative Design Principles was frequently mentioned, emphasising its significance in sustainable agriculture. Sub-themes within this category include the importance of regenerative design (54 mentions), strategies for implementation (56 mentions), environmental and sustainability benefits (87 mentions), and challenges in adoption (83 mentions). Participants discussed various methods such as holistic management principles, adaptive grazing, and minimal soil disturbance and highlighted benefits such as increased soil carbon, improved water infiltration, and enhanced biodiversity. However, they noted challenges, including old mindsets, education needs, and financial constraints. These findings are detailed in Figure 2.

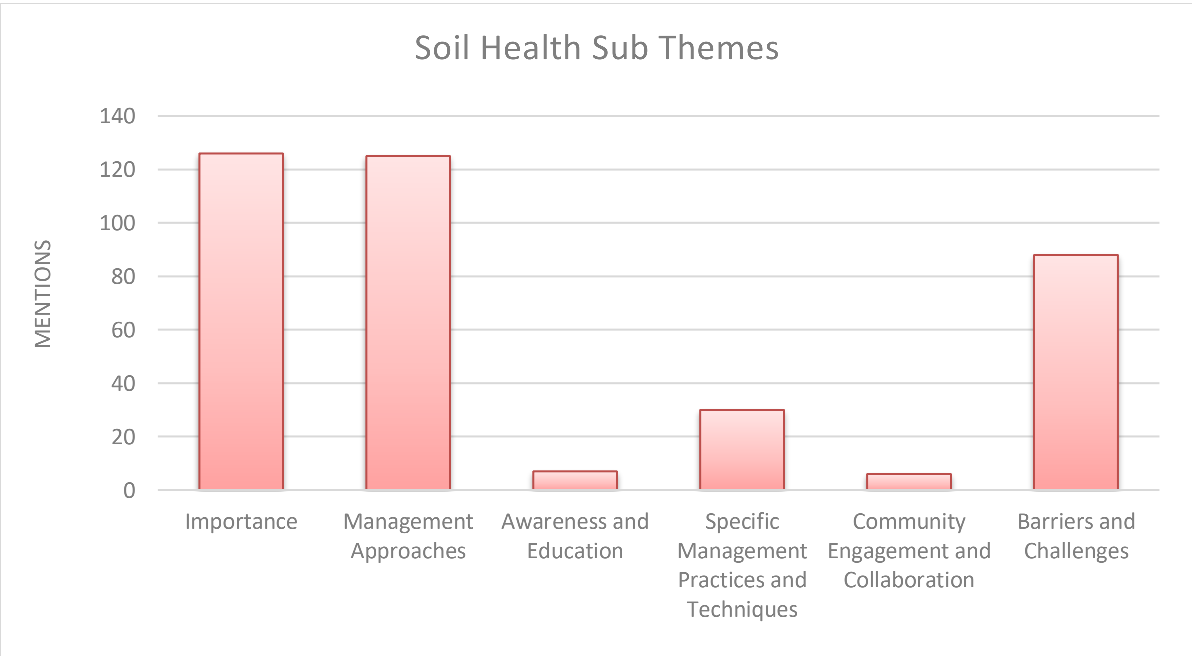
Figure 2: Breakdown of Regenerative Design Principles into Sub-Themes



7.3 Soil Health

Soil health emerged as a fundamental pillar of sustainable farming, with several sub-themes highlighting its importance. The significance of soil health was mentioned 126 times, while approaches to managing soil health received 125 mentions, focusing on scientific and regenerative practices. Despite its importance, awareness and education about soil health were only mentioned 7 times, indicating a need for increased educational efforts. Specific management practices and techniques, such as grazing management and soil testing, were mentioned 30 times. Community engagement and collaboration in soil health management had 6 mentions, while barriers and challenges, including economic pressures, lack of knowledge, climate factors, and traditional mindsets, were highlighted 88 times. These details are represented in Figure 3.

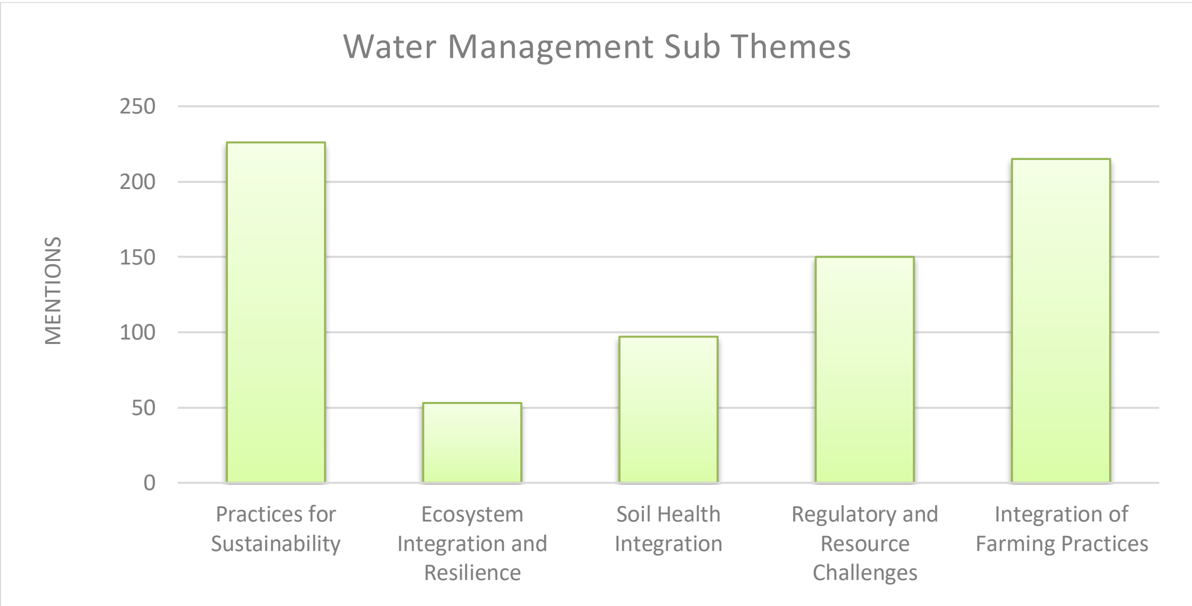
Figure 3: Breakdown of Soil Health into Sub-Themes



7.4 Water Management

Water management was another critical area of focus, with practices for sustainability receiving 226 mentions. The role of water management in enhancing farm sustainability was emphasised, along with ecosystem integration and resilience (53 mentions), soil health integration (97 mentions), and regulatory and resource challenges (150 mentions). Participants discussed strategies such as riparian management, agroecological techniques, and data-driven decision-making, which were mentioned 215 times. These insights are presented in Figure 4.

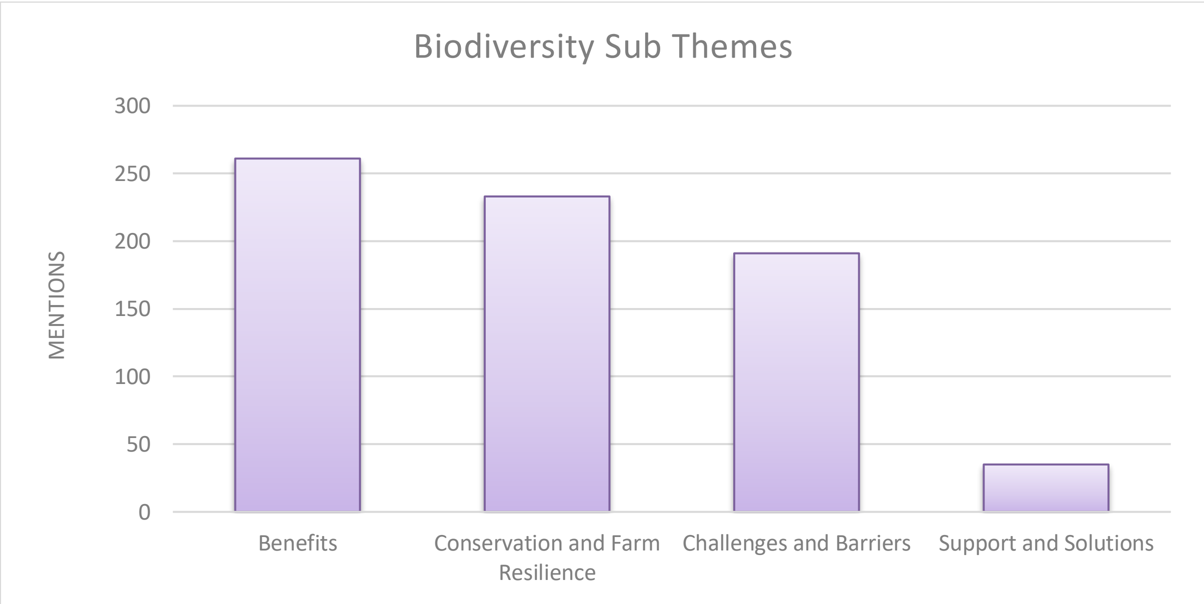
Figure 4: Breakdown of Water Management into Sub-Themes



7.5 Biodiversity

Biodiversity was underscored as a crucial element of sustainable farming. The benefits of biodiversity were highlighted 261 times, emphasising its foundational role in ecological health, soil fertility, and ecosystem services. Biodiversity conservation and farm resilience received 233 mentions, discussing its role in enhancing farm resilience and integrating sustainable practices. However, challenges and barriers to biodiversity conservation, including cost constraints and lack of awareness, were noted 191 times. Participants also mentioned support and solutions for biodiversity conservation 35 times, stressing the need for incentives, policy support, and educational research. These findings are summarised in Figure 5.

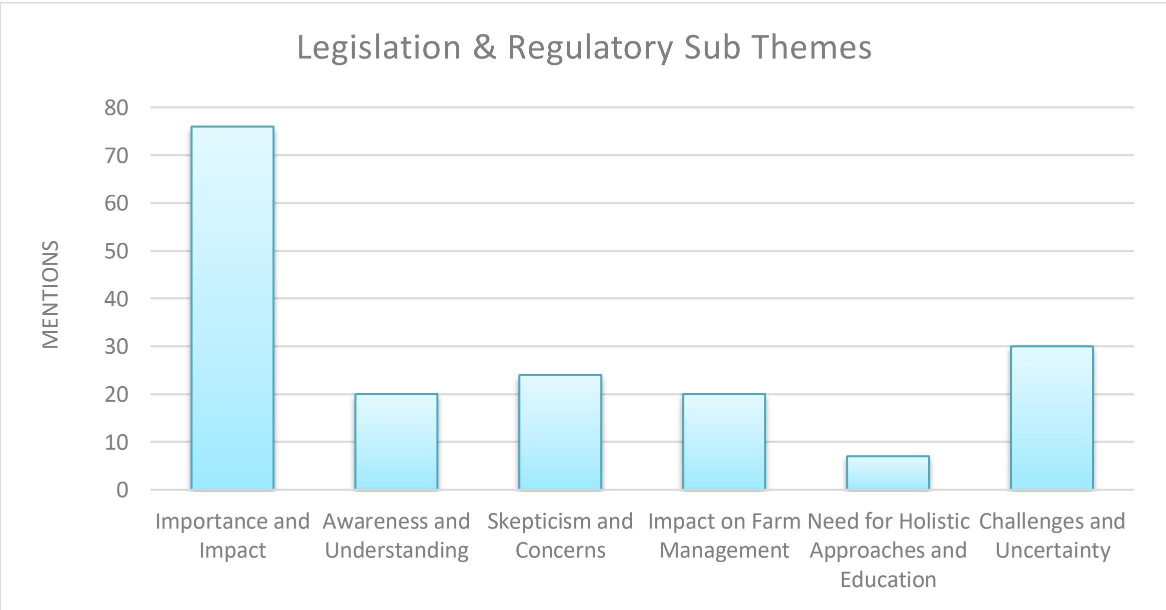
Figure 5: Breakdown of Biodiversity into Sub-Themes



7.6 Legislation and Regulatory Frameworks

Legislation and regulatory frameworks also played a significant role, with several sub-themes identified. The importance and impact of legislation, particularly the Resource Management Act, were mentioned 76 times. Participants' awareness and understanding of sustainability legislation were mentioned 20 times, while scepticism and concerns about the effectiveness of legislative interventions were noted 24 times. The impact on farm management of legislation received 20 mentions, examining how laws influence farm design, practices, and economic viability. The need for holistic approaches and education in sustainable farming was mentioned 7 times, highlighting the importance of a comprehensive strategy and educational initiatives. Lastly, challenges and uncertainty regarding the regulatory landscape were mentioned 30 times. These insights are detailed in Figure 6.

Figure 6: Breakdown of Legislation and Regulatory Frameworks into Sub-Themes



7.7 SWOT Analysis of the Regenerative Farm Plan

The SWOT analysis presented in this section showcases the opportunities and challenges of developing a regenerative farm blueprint by drawing upon insights from the literature and survey responses. This structured evaluation highlights the strengths, weaknesses, opportunities, and threats associated with the regenerative farm blueprint. By synthesising these insights, the analysis aims to guide the development of effective strategies for promoting the adoption of regenerative practices. It underscores the importance of supporting environmental health and enhancing economic viability and social well-being, positioning regenerative farming as a crucial driver of sustainable agricultural development.

7.7.1 Strengths

Holistic Ecosystem Management: The regenerative farm blueprint emphasises integrating natural processes into farming practices, enhancing biodiversity, and improving soil health. Adaptive grazing management and silvopasture create self-sustaining ecosystems that reduce dependency on external inputs and promote ecological balance and resilience against environmental stresses. Survey respondents highlighted the importance of designing farms to be "*harmonic with nature and the landscape; self-replenishing and cycling of all-natural components on the farm*," emphasising the multifaceted understanding of regenerative agriculture, which was also highlighted in Teague and Kreuter (2020) and Savory and Butterfield (1998).

Long-term Sustainability: Prioritizing practices that enhance soil and water quality, the regenerative farm blueprint supports the continuous improvement of farm ecosystems. This long-term perspective ensures that farming activities contribute to the regeneration and health of the natural environment, balancing environmental health, economic viability, and social well-being. By fostering biodiversity and ecosystem services, regenerative farming practices contribute to greater resilience against climate variability and other environmental stresses. Survey respondents noted the critical role of regenerative principles in building more resilient and productive agricultural systems, as also noted within Wezel (2017a) and Teague *et al.* (2016).

Innovative Practices: Innovative practices such as no-till farming and precision agriculture enhance farm resilience and productivity. These methods reduce soil erosion, increase water retention, and improve overall soil health, leading to higher crop yields and better resistance to pests and diseases. Precision agriculture technologies enable efficient resource use, optimising inputs like water and fertilisers and minimising environmental impacts while maintaining high productivity levels (González-Chang *et al.* 2020).

Enhanced Water Management: Efficient use of water resources is a cornerstone of the regenerative farm blueprint. Advanced irrigation techniques, such as drip irrigation and soil moisture monitoring, help optimise water use, ensuring crops receive adequate hydration without waste. Riparian buffers and nutrient management also prevent water pollution and enhance water quality. Respondents highlighted the importance of strategies like *"efficient water use that avoids over and underwatering"* and *"waterway protection through biodynamic methods"* to improve water quality and sustainability, as also expressed by Fischer *et al.* (2014) and MoE (2024c).

7.7.2 Weaknesses

Financial Constraints: Implementing regenerative practices often requires substantial initial investments in advanced technologies, soil health improvements, and infrastructure upgrades.

These upfront costs can be prohibitively expensive for many farmers, deterring them from adopting these practices despite the long-term benefits. Financial constraints also impact the ability to maintain and scale regenerative practices over time. Respondents noted that *"the required earthworks can be expensive, and there is no immediate return on the outlay,"* highlighting the economic challenges faced by farmers, a concern also raised in LaCanne and Lundgren (2018) and Monbiot (2022).

Knowledge Gaps: A significant barrier to implementing regenerative practices is farmers' and stakeholders' lack of knowledge and understanding of how to develop these systems effectively. Effective implementation requires a deep understanding of ecological principles and the specific techniques that promote soil health and biodiversity. Farmers may struggle to adopt and sustain regenerative practices without adequate education and training. Survey respondents emphasised the need for better educational resources and training, citing *"knowledge and education gaps"* as significant obstacles. These concerns were also raised in Grelet *et al.* (2021).

Regulatory Burdens: Compliance with existing regulatory frameworks can be complex and burdensome, particularly for smaller farms. Environmental impact, water use, and land management regulations often require detailed reporting and adherence to strict guidelines. Navigating these regulatory requirements can be time-consuming and costly, adding to farmers' challenges. Simplifying regulatory processes and providing guidance on integrating regenerative practices within existing frameworks can help alleviate these burdens. Respondents highlighted the need for *"clear objectives and actions to reduce farming impact in freshwater systems", also noted in MoE (2022) and* MoE (2023d).

7.7.3 Opportunities

Market Demand and Consumer Awareness: The rising global demand for environmentally friendly products offers significant opportunities for farmers to differentiate their products and command premium prices through effective branding. Emphasising the environmental and social benefits of regenerative farming can enhance consumer trust and loyalty, opening new markets and fostering sustainable business models. By highlighting the positive impacts of regenerative practices, farmers can appeal to a growing segment of eco-conscious consumers. Respondents emphasised the potential for branding to enhance market access and command premium prices, a strategy supported by Wezel (2017b) and Beef&LambNZ (2020).

Community Engagement and Education: Integrating traditional knowledge systems and increasing awareness through educational initiatives can help bridge knowledge gaps and promote adopting regenerative practices. Collaborative governance frameworks that recognise and incorporate diverse perspectives are essential for effective policy implementation. Engaging communities in designing and implementing regenerative farming projects can enhance social acceptance and support for these initiatives. Respondents noted the importance of *"community engagement and education"* in fostering a culture of sustainability as also highlighted in Wezel (2017a) and Bernard and Véronique (2002).

Government Initiatives and Support Mechanisms: Ongoing government support and adaptive policy frameworks can foster collaboration, research, and evidence-based practices necessary for the broader adoption of sustainable practices. Financial incentives, such as those provided by the Emissions Trading Scheme and the Carbon Farming Initiative, can mitigate the financial risks of transitioning to regenerative practices. Continued government commitment is crucial for creating an enabling environment for regenerative agriculture. Respondents highlighted the role of government initiatives in supporting sustainable practices, as highlighted by Wallace (2023) and Waikato (2015).

Outcome Tracking and Innovation: Advances in soil testing and monitoring techniques enable rapid and cost-effective analyses, aiding informed decision-making regarding soil management practices. Successful case studies and technological advancements facilitate the integration of FWFPs with regenerative farming principles, promoting sustainability and resilience. These innovations can help farmers track progress, demonstrate the benefits of regenerative practices, and refine their approaches based on real-time data. Respondents emphasised the importance of monitoring and adaptation in achieving sustainable outcomes. Monitoring these outcomes was also seen as critical within Johnson (2021).

7.7.4 Threats

Climate Change and Environmental Pressures: Adapting to climate variability and extremes presents a significant challenge, requiring robust and flexible farming practices. Continued environmental degradation and biodiversity loss can undermine the benefits of regenerative practices if not effectively managed. Ensuring regenerative farming systems are resilient to changing environmental conditions is critical for long-term success. Respondents highlighted the need for resilience to climate risk and long-term sustainability, also highlighted in Haase *et al.* (2018).

Technological Barriers: Limited access to advanced technologies and technical support can hinder the adoption of precision farming and AI tools, especially for smaller farms. Ensuring that all farmers have access to the necessary technological resources is crucial for the widespread adoption of regenerative practices. Overcoming these barriers requires investment in rural infrastructure and capacity-building programs. Respondents noted that *"limited knowledge and technical support"* are significant challenges González-Chang *et al.* (2020).

Economic and Financial Risks: Fluctuations in market demand and commodity prices can impact the financial viability of regenerative farming practices, posing risks to farmers' income stability. High upfront investment costs and the uncertainty of returns can deter farmers from transitioning to regenerative practices. Addressing these economic and financial risks requires comprehensive support mechanisms and market strategies that ensure the economic sustainability of regenerative farms (LaCanne and Lundgren 2018; Fenster *et al.* 2021). Respondents highlighted farmers' financial challenges and economic pressures.

8 Discussion

The transition from conventional Freshwater Farm Plans (FWFPs) to Regenerative Farm Plans represents a significant advancement in sustainable agriculture. FWFPs offer comprehensive guidelines for assessing and managing farm environmental risks, drawing from regulatory frameworks such as the Resource Management Act and the National Environmental Standards for Freshwater. The primary goal of FWFPs is to identify and mitigate the potential of on-farm environmental risks through Good Management Practices (GMPs). Each FWFP is customised to align with the unique characteristics of each property and the specific farming objectives of the operator.

However, conventional farming practices pose significant challenges, including biodiversity loss, habitat transformation, and water pollution. Addressing these challenges necessitates integrating regenerative farming principles into the FWFP framework. Regenerative farming goes beyond mere sustainability; it aims to restore and enhance natural ecosystem processes that conventional farming often disrupts. This approach focuses on improving soil health, increasing biodiversity, enhancing water retention, and building resilient agricultural systems adapting to environmental changes.

A regenerative farm blueprint is essential to adapt the current FWFP reporting system to incorporate regenerative farming principles. This blueprint will guide farmers in designing and implementing regenerative farming systems while ensuring compliance with FWFP requirements. By aligning the goals of FWFPs with regenerative agriculture principles, the blueprint aims to foster a holistic approach to farming that supports long-term environmental health, economic viability, and social well-being.

The survey questionnaire (Appendix 1) included several categories of questions derived from key concepts identified in the literature review as critical for adapting freshwater farm plans into a regenerative farm blueprint. The following section aims to connect the insights from the thematic analysis (Figures 1 and 2) to these survey sections and explain how they contribute to developing the regenerative farm blueprint.

8.1 Addressing Challenges with a Systems-Based Approach

Creating a regenerative farm design can be challenging due to the need to rebuild agricultural resources and the complex nature of farming ecosystems (Martin *et al.* 2019). These challenges can be overcome by adopting a systems-based approach to regenerative farming (Savory and Butterfield 1998). This involves understanding the complex interactions between different components of the farm ecosystem and adopting practices that improve the health and resilience of the system as a whole (Teague and Kreuter 2020).

8.2 Designing Innovative Farming Systems

Designing regenerative farms requires a significant shift in thinking and farming practices. Regenerative agriculture is not merely a set of practices but a holistic approach requiring an understanding of underlying principles and systems thinking. Many farmers may lack the knowledge and experience to implement regenerative agriculture practices effectively.

Two approaches to designing innovative farming systems are the 'de novo' and 'step-by-step' design (Meynard *et al.* 2012). The 'de novo' approach involves designing a new system from scratch, while the 'step-by-step' approach involves gradually improving the existing system. Biggs *et al.* (2012) propose seven principles to guide the development of regenerative agricultural systems:

1. **Diversity and Redundancy**: Stability increases with a balanced species diversity carrying out various roles. Redundancy ensures that the loss of individual species does not result in a loss of function within the ecosystem.

2. **Connectivity**: Connections between species within an ecosystem or neighbouring ecosystems facilitate the exchange of energy, biomatter, information, and other resources, supporting ecosystem functions and social processes.

3. **Slow Variables and Feedbacks**: Agricultural ecosystems consist of variables that change and interact on various timescales. Slow variables create the environmental context, while fast variables are interactions between living things and their environment. Feedback can either self-reinforce (positive feedback) or dampen (negative feedback) changes.

4. **Understanding Social-Ecological Systems as Complex Adaptive Systems**: Managers need to adopt a mindset sensitive to the system's complex functions and dynamics, learning and experimenting to manage uncertainty and disturbance adaptively.

5. **Learning and Experimentation**: Managing complexity requires constant learning, modifying existing knowledge, and acquiring new knowledge. Monitoring and experimentation are key to observing and comparing outcomes.

6. **Broaden Participation**: Broader participation in the learning process increases acceptance of changes in land management practices. Transparency and feedback from all parties' guide management.

7. **Adaptive Management**: This approach involves continuously improving management practices based on feedback and observations from the farm ecosystem, ensuring long-term sustainability and resilience.

8.3 Integration of Regenerative Design Principles

Survey responses emphasised the importance of holistic ecosystem management, biodiversity maximisation, and viewing farms as complex adaptive systems in regenerative agriculture. One respondent defined regenerative agriculture as "*a design that is harmonic with nature and the landscape; self-replenishing and cycling of all-natural components on the farm.*" Practical strategies for regenerative farming include holistic farm planning, adaptive grazing management, and minimal soil disturbance practices, such as no-till with cover crops (11 mentions). The environmental benefits, including reduced biodiversity loss, improved soil health, enhanced water infiltration, and increased resilience to climate risk, were highlighted by a respondent stating, "*Regenerative agriculture focuses on ecosystem health, soil function, and rebuilding natural cycles, all of which have positive, measurable outcomes for the environment*" (24 mentions). However, challenges such as entrenched mindsets (24 mentions), knowledge gaps (23 mentions), financial barriers (18 mentions), and climate change pressures (9 mentions) necessitate targeted efforts to promote mindset shifts, education, and financial support.

8.4 Business Strategies in Sustainable Farming

The survey highlights the need for a long-term perspective in farm business strategies, viewing farms as complex adaptive circular ecosystems with formal planning processes spanning generations. One respondent emphasised, "*an intergenerational approach to business, incorporating formal planning processes in all areas of physical, financial, environmental, and social outcomes that span many generations of farmers and growers*" (9 mentions). Diversification aligns with regenerative principles and enhances farm resilience by stacking enterprises and avoiding over-reliance on a single income source (11 mentions). The importance of monitoring and adaptation is underscored, allowing for continuous improvement and innovation, which aligns closely with regenerative farming principles (9 mentions).

8.5 Role of Freshwater Farm Plans in Sustainability Integration

Freshwater farm plans (FWFPs) are pivotal in integrating sustainability practices within agricultural systems, as noted by a respondent emphasising *"certified plans with maps with clear objectives and actions to reduce farming impact in freshwater systems"* (14 mentions). Key components include water resource management, environmental impact mitigation, and biodiversity conservation, illustrated by a respondent's advocacy for *"waterway protection through biodynamic methods; fenced waterways, exploiting the value of wetlands"* (6 mentions). Incorporating regenerative design principles into FWFPs is seen as essential, focusing on reducing chemical inputs to enhance soil fertility and ecosystem health (6 mentions). Financial constraints and regulatory burdens are significant barriers, with a respondent noting, *"the required earthworks can be expensive, and there is no immediate return on the outlay"* (18 mentions). However, the report emphasises that overcoming these challenges is within our collective power, requiring industry leadership and clear guidance.

8.6 Soil Health Management

Soil health is not just a component but the foundation of sustainable agriculture, with respondents unanimously emphasising its critical role. One respondent stated, *"It's the foundation, literally and metaphorically"* (69 mentions). Regenerative farming practices prioritising soil health enhance soil fertility, biodiversity, and resilience; as noted by a respondent, *"Regenerative principles result in building more resilience and productive capacity"* (16 mentions). The interconnectedness of soil health with farm profitability, ecosystem services, and global food security is highlighted, with respondents noting its importance in driving profitability (14 mentions). However, the report also highlights the urgent need to address the economic pressures (17 mentions), knowledge gaps (16 mentions), and damaging practices such as the overuse of fertilisers and pesticides that pose significant obstacles. Addressing these challenges requires immediate action, education, policy reform, and technological innovation.

8.7 Water Management Strategies

Water management is crucial for farm sustainability, with respondents unanimously stressing its importance. One respondent emphasised, "*without good quality water, we will be unable to farm effectively for future generations*" (82 mentions). Efficient water use, including drip irrigation and soil moisture monitoring (78 mentions), is key. Water quality improvement measures such as riparian buffers and nutrient management (26 mentions) are essential for protecting aquatic ecosystems.

Conservation strategies like rainwater harvesting and recharge (22 mentions) are also advocated. Challenges include financial constraints (47 mentions) and lack of technical support (37 mentions), necessitating collaborative efforts to ensure long-term water resource viability.

8.8 Biodiversity Conservation

Biodiversity is essential for ecological health, soil health, pollination, and pest regulation. One respondent emphasised, "*biodiversity is crucial for a balanced ecological health of the land and generating healthy soils*" (84 mentions). The biodiversity benefits for soil health and fertility were underscored, with diverse plant communities improving soil biology and nutrient cycling (82 mentions). However, cost and resource constraints (46 mentions) and lack of knowledge (36 mentions) hinder conservation practices. Financial risks and economic pressures deter farmers from prioritising biodiversity conservation (33 mentions). Addressing these challenges requires mindset shifts, policy support, and educational initiatives.

8.9 Perception of Legislative Frameworks

Survey responses provide insights into farmers' perspectives on existing regulations. The Resource Management Act (RMA) 1991 is pivotal for sustainable land management (14 mentions). Some participants acknowledged its importance, while others questioned its comprehension of holistic management practices. One respondent stated, "*I'm ignoring the legislation as it doesn't understand what holistic management and grazing practices do*" (6 mentions). Discussions revealed mixed levels of familiarity with the legislation, with some showing reasonable understanding (8 mentions) and others expressing scepticism (6 mentions). Climate change legislation, including carbon trading, drew varying awareness and interest (5 mentions). Effective education and personal commitment are crucial for driving sustainable practices.

9 Conclusions

This study underscores the critical importance of transitioning from conventional Freshwater Farm Plans (FWFPs) to Regenerative Farm Plans (RFPs) to achieve sustainable agriculture in New Zealand. Integrating regenerative principles into FWFPs offers a holistic approach to farming, addressing key environmental challenges such as soil degradation, biodiversity loss, and water pollution. This transition is essential for mitigating the adverse effects of traditional farming practices and meeting the global demand for sustainably produced food.

Key findings highlight the necessity of incorporating regenerative design principles focusing on holistic ecosystem management and biodiversity enhancement. Survey responses indicate that practical strategies such as holistic farm planning, adaptive grazing management, and minimal soil disturbance are crucial for improving soil health and increasing resilience to climate change. However, these practices face significant challenges, including financial constraints, knowledge gaps, and regulatory hurdles, which must be systematically addressed.

Business strategies play a significant role in successfully implementing sustainable farming practices. Long-term planning, diversification, and continuous monitoring are essential for enhancing farm resilience and profitability. The study emphasises the potential of branding regenerative products to tap into new markets and achieve premium pricing, driven by increasing consumer demand for environmentally friendly products. Additionally, government support through financial incentives and adaptive policy frameworks is vital for promoting the widespread adoption of regenerative practices.

The potential of silvopasture systems is particularly noteworthy. Integrating trees and shrubs with livestock grazing systems can diversify production and improve habitat quality, restoring biological diversity on New Zealand farms. Silvopasture offers numerous benefits, including providing shade and shelter for livestock, reducing soil erosion, enhancing carbon sequestration, and increasing farm productivity. This approach significantly contributes to the conservation of native biodiversity. It enhances ecological resilience, aligning with the study's aim to create balanced and resilient agricultural systems that mimic natural ecosystems and ensure long-term sustainability and productivity.

10 Recommendations

To propel the evolution of regenerative farm blueprints and fortify the sustainability of New Zealand's agricultural sector, we propose the following recommendations, each holding the promise of a more resilient and prosperous future:

1. **Conduct Comprehensive Risk Assessments:**
   - **Identify and Map Vulnerabilities:** Perform detailed assessments to identify and map environmental vulnerabilities and risks associated with farming activities on each land unit. This step is crucial for developing targeted strategies to mitigate these risks effectively.
   - **Tailored Risk Mitigation Strategies:** Develop and implement risk mitigation strategies tailored to each farm's specific conditions and needs, ensuring they address identified vulnerabilities comprehensively.
2. **Implement Good Management Practices:**
   - **Integrate Existing and New Actions:** Combine existing best practices with innovative actions to avoid, remedy, or mitigate identified environmental risks. Focus on realistic and achievable goals tailored to each farm's unique conditions.
   - **Continuous Improvement:** Establish mechanisms for continuous improvement and adaptation of management practices to enhance sustainability outcomes over time.
3. **Monitor and Track Outcomes:**
   - **Advanced Monitoring Techniques:** Use advanced soil testing, water quality monitoring, and biodiversity assessments to understand ecosystem dynamics better. Regular monitoring will inform decision-making and ensure continuous improvement in farming practices.
   - **Data-Driven Decision Making:** Implement data-driven approaches to track progress and make informed decisions supporting the long-term sustainability of farming operations.
4. **Engage Stakeholders and Provide Education:**
   - **Enhance Community Engagement:** Foster community engagement by involving local stakeholders, including farmers, indigenous communities, and environmental groups, in planning and implementing regenerative practices.
   - **Educational Initiatives:** Develop and offer educational programs and resources to promote awareness and understanding of regenerative practices among farmers and other stakeholders. Incorporate traditional knowledge systems and contemporary scientific insights to enhance learning outcomes.
5. **Leverage Technological Advancements:**
   - **Precision Farming Tools:** Employ precision farming tools and AI-driven platforms to optimise resource management, improve efficiency, and support carbon credit

accounting. These technologies facilitate the adoption and management of regenerative practices by providing real-time insights and data analytics.

    - **Innovation in Farming Practices:** Encourage adopting innovative farming practices, such as no-till farming, cover cropping, and rotational grazing, which enhance soil health and increase resilience to environmental changes.

6. **Promote Silvopasture Systems:**
    - **Integration of Trees and Shrubs:** Promote the integration of trees and shrubs into pasturelands to create diverse and resilient agroecosystems. Silvopasture systems can enhance biodiversity, improve soil health, and provide additional income streams through timber, fruit, and nut production.
    - **Habitat Quality Improvement:** Encourage silvopasture to improve habitat quality, supporting a wide range of species and contributing to the conservation of native biodiversity.

By implementing these recommendations, New Zealand can develop balanced and resilient agricultural systems that mimic natural ecosystems, improve soil health, increase biodiversity, enhance water retention, and build robust systems that adapt to environmental changes. Addressing the diverse needs of stakeholders, especially small to medium-sized agricultural enterprises, these practical insights aim to facilitate effective implementation and ensure long-term sustainability and productivity in New Zealand's agricultural sector.

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12 Appendix

12.1 Appendix 1: Survey Questionnaire:

Introduction and Consent Form

Introduction:

Thank you for considering participation in my study. Before we proceed, please take a moment to review the following information and indicate your consent to participate.

I am Richard Pedley and I am conducting this study as part of the Kellogg Rural Leaders Programme with Lincoln University. If you have any questions about this survey or study please contact me at richard@regenpreneur.com.

In this survey, I aim to explore avenues for promoting environmental sustainability within pastoral agriculture farms in New Zealand.

Your input is pivotal in unravelling perceptions and challenges concerning legislative frameworks, regenerative design principles, freshwater farm plans, business strategies, soil health management, water management strategies, and biodiversity conservation within the domain of sustainable farming practices.

Your participation not only enriches our understanding of sustainable agricultural practices but also contributes to fostering a more resilient and environmentally conscious farming sector in New Zealand. Your insights are invaluable, and I sincerely appreciate your time and contribution to this study.

Estimated Structure and Duration:

This survey comprises seven sections, each exploring various aspects of sustainable farming practices.

- **Regenerative Design Principles:** Understand participants' definitions, implementation strategies, associated benefits, and anticipated challenges.
- **Freshwater Farm Plans:** Examine key components, integration of regenerative design principles, and implementation challenges.
- **Business Strategies:** Explore types, evolution, influence on sustainability outcomes, and relationship with farming practices.
- Soil Health Management: Gain insights into soil health importance, effective techniques, and common challenges.
- **Water Management Strategies:** Investigate contributions to sustainability, observed/implemented strategies, and integration challenges.

- **Biodiversity Conservation:** Understand the role of biodiversity conservation, successful strategies, and encountered challenges.
- **Legislative Frameworks:** Assess familiarity with sustainability legislation, its impact on farm design practices, and compliance challenges.

Total Questions: 22
Expected Completion Time: 40-50 minutes

Consent Details:

By agreeing to participate in this study, you acknowledge the following:

1. **Voluntary Participation:** You agree to participate in this research voluntarily, without coercion or external pressure.
2. **Right to Withdraw:** You understand that you have the right to withdraw from the study at any time, and you may refuse to answer any question without facing consequences.
3. **Withdrawal of Data:** You are aware that you can withdraw the use of data collected from your interview within two weeks after the interview, after which the material will be deleted.
4. **Understanding of Study:** You have been provided with a written explanation of the purpose and nature of the study and have had the opportunity to ask questions regarding the study.
5. **Assistance to Researcher:** You acknowledge that participating involves answering a range of research questions to assist the researcher in gathering information.
6. **No Direct Benefits**: You understand that your participation in this research does not yield any direct benefits.
7. **Confidentiality:** You acknowledge that all information provided during this study will be treated confidentially.
8. Anonymity: You are aware that your identity will remain anonymous in any reports or publications resulting from this research.
9. **Contact Information:** You have been provided with contact information for any further inquiries or concerns.
10. **Briefing on Survey:** You have been briefed on the structure and estimated duration of the survey.
11. **Data Security:** You understand that responses to interviews will be kept in a password-protected folder and will be destroyed on completion of the study.
12. **Agreement to Proceed:** You agree to proceed with the survey as outlined.

Consent:

If you consent to participate, please sign below.

[Name] ___________________________

[Email] ____________________________

[Date] ____________________________

Questionnaire

Survey: Understanding Sustainable Farming Practices

Section 1: Integration of Regenerative Design Principles

1. How would you define regenerative design principles in agriculture?
2. What strategies do you think are most effective for implementing regenerative design on farms?
3. What environmental and sustainability benefits do you associate with regenerative design practices in agriculture?
4. What challenges do you foresee in adopting and implementing regenerative design principles on farms?

Section 2: Role of Freshwater Farm Plans in Sustainability Integration

5. What are the key components and objectives of freshwater farm plans, as you understand them?
6. How do you think regenerative design principles can be effectively integrated into freshwater farm plans?
7. What challenges and barriers do you perceive in implementing regenerative design within freshwater farm plans?

Section 3: Business Strategies in Sustainable Farming

8. What types of business strategies do you believe are most commonly adopted by sustainable farms?
9. How do these business strategies influence sustainability outcomes in farming, in your opinion?
10. Do you see a clear relationship between business strategies and sustainable farming practices? Please explain.

Section 4: Soil Health Management

11. How important is soil health for sustainable farming, in your view?
12. What techniques or practices do you believe are most effective in improving soil health on farms?
13. What challenges do farmers commonly face in maintaining soil health on their farms?

Section 5: Water Management Strategies

14. How do you believe water management contributes to sustainability in farming?
15. What strategies have you observed or implemented on farms to effectively manage water?

16. What challenges and successes have you encountered in integrating water management strategies into sustainable farming practices?

Section 6: Biodiversity Conservation

17. How does biodiversity conservation contribute to sustainability in farming, in your opinion?
18. What strategies have you seen or employed to enhance biodiversity on farms?
19. What challenges have you faced in implementing biodiversity enhancement strategies on farms?

Section 7: Perception of Legislative Frameworks

20. How familiar are you with sustainability legislation in New Zealand?
21. What provisions within the Zero Carbon Act, Environmental Reporting Act, and Emissions Trading Scheme do you think impact farm design practices the most?
22. What challenges do you think agricultural businesses face in complying with sustainability legislation in New Zealand?

Thank you for participating in this survey. Your insights will contribute to understanding sustainable farming practices and their integration into agricultural operations.

12.2 Appendix 2: Survey Interpretation

12.2.1 Section 1: Integration of Regenerative Design Principles

Section 1 Key Themes

Theme: Regenerative Design Principles in Agriculture

- Holistic Approach to Ecosystem Health: 13 mentions
- Maximizing Biodiversity and Soil Health: 11 mentions
- Balancing Economic and Environmental Goals: 10 mentions
- Integration of Natural Processes: 10 mentions
- Continuous Improvement and Adaptation: 10 mentions

Theme: Strategies for Implementing Regenerative Design on Farms

- Holistic Management Principles: 14 mentions
- Adaptive Grazing Management: 13 mentions
- No-Till and Minimal Soil Disturbance: 11 mentions

- Diverse Crop and Pasture Systems: 9 mentions
- Soil Health Monitoring and Management: 9 mentions

Theme: Environmental and Sustainability Benefits of Regenerative Design Practices

- Reduction in Planetary Boundary Transgressions: 24 mentions
- Increased Soil Carbon and Water Infiltration: 16 mentions
- Enhanced Soil Preservation and Biodiversity: 10 mentions
- Economic and Environmental Sustainability: 20 mentions
- Resilience to Climate Risk and Long-Term Focus: 17 mentions

Theme: Challenges in Adopting and Implementing Regenerative Design Principles

- Mindsets and Old School Thinking: 24 mentions
- Knowledge and Education: 23 mentions
- Financial Challenges: 18 mentions
- Climate Change and External Pressures: 9 mentions
- Cultural and Social Factors: 9 mentions

12.2.2 Section 2: Role of Freshwater Farm Plans in Sustainability Integration

Key Themes

Theme: Regulation and Compliance

- Regulation and Compliance (14)
- Regulatory and Compliance Burdens (6)
- Lack of Clear Definitions and Understanding (6)

Theme: Environmental Management

- Environmental Impact Mitigation (9)
- Ecosystem Management and Riparian Zones (6)
- Soil Health and Nutrient Management (5)

Theme: Implementation Challenges

- Lack of Understanding and Awareness (19)
- Barriers and Challenges (16)
- Financial and Resource Constraints (9)

Theme: Holistic Approach

- Holistic Approach to Farm Planning (4)
- Integrated Farm Planning (2)
- Need for Industry Leadership and Guidance (5)

Theme: Community Engagement and Education

- Community and Catchment Approach (6)
- Community Engagement and Education (3)

12.2.3 Section 3: Business Strategies in Sustainable Farming

Key Themes

Theme: Long-term Sustainability

- Long-term Perspective & Understanding Farms as Complex Adaptive Circular Ecosystems (9 responses)
- Strategic Planning and Operational Planning (7 responses)
- Diversification and Stacking Enterprises (6 responses)
- Regenerative Principles and Practices (6 responses)
- Cost Reduction and Financial Sustainability (6 responses)

Theme: Financial Management and Profitability

- Economic Viability (8 responses)
- Cost Reduction and Financial Sustainability (6 responses)
- Community Engagement and Branding (5 responses)
- Economic Viability (4 responses)
- Monitoring and Adaptation (4 responses)

Theme: Environmental Stewardship and Ecosystem Health

- Regenerative Principles and Practices (6 responses)
- Low Input Systems and Soil Health Focus (5 responses)
- Integrated Farm Management and Crop Rotation (4 responses)
- Balancing Economic and Environmental Sustainability (4 responses)
- Environmental Stewardship (4 responses)

Theme: Adaptability and Continuous Improvement

- Monitoring and Adaptation (5 responses)
- Integrated Farm Management and Crop Rotation (4 responses)
- Balancing Economic and Environmental Sustainability (4 responses)
- Adaptability and Continuous Improvement (4 responses)
- Knowledge and Education (4 responses)

Theme: Diversification and Resilience

- Diversification and Stacking Enterprises (6 responses)
- Low Input Systems and Soil Health Focus (5 responses)
- Community Engagement and Branding (5 responses)
- Integrated Farm Management and Crop Rotation (4 responses)
- Balancing Economic and Environmental Sustainability (4 responses)

12.2.4 Section 4: Soil Health Management

Section 5 Key themes:

Theme: Importance of Soil Health

- Critical Importance: 69 responses
- Foundational Role: 22 responses
- Regenerative Potential: 16 responses
- Economic and Environmental Impact: 14 responses
- Long-Term Perspective: 5 responses

Theme: Approaches to Soil Health Management

- Scientific Approach: 46 responses
- Regenerative Practices: 28 responses
- Customization and Adaptation: 21 responses
- Holistic Management: 16 responses
- Reduction of Chemical Inputs: 14 responses

Theme: Awareness and Education

- Education and Awareness: 7 responses

Theme: Management Practices and Techniques

- Integrated Approach: 6 responses
- Grazing Management: 9 responses
- Soil Testing and Monitoring: 8 responses
- Conservation Tillage: 7 responses

Theme: Community Engagement and Collaboration

- Community and Stakeholder Engagement: 6 responses

Theme: Barriers and Challenges

- Economic Pressures: 17 responses
- Lack of Knowledge/Understanding: 16 responses
- Climate and Environmental Factors: 13 responses
- Traditional Practices and Mindsets: 11 responses
- Policy and Regulation: 6 responses
- Practices Damaging Soil Health: 6 responses
- Transition Challenges: 6 responses
- Pesticide and Chemical Usage: 5 responses
- Soil Erosion: 4 responses
- Neighbour Practices: 3 responses

12.2.5 Section 5: Water Management Strategies

Section 5 Key Themes

Theme: Water Management Practices for Sustainability

- Water management contributes to farm sustainability - 82 mentions
- Efficient water use - 78 mentions
- Water quality improvement - 26 mentions
- Conservation of water resources - 22 mentions
- Sustainable water use reduces costs - 18 mentions

Theme: Ecosystem Integration and Resilience

- Incorporating water into broader ecosystem management - 20 mentions
- Water management enhances biodiversity and ecosystem resilience - 17 mentions
- Adapting to climate variability and extremes - 16 mentions

Theme: Soil Health and Integration

- Integration of water management with soil health - 66 mentions
- Soil health and water infiltration - 31 mentions

Theme: Regulatory and Resource Challenges

- Financial constraints and investment requirements - 47 mentions
- Lack of knowledge and technical support - 37 mentions
- Infrastructure and technology challenges - 25 mentions
- Regulatory and policy hurdles - 21 mentions
- Limited access to technical support and resources - 20 mentions

Theme: Farming Practice Integration

- Riparian management and stream protection - 34 mentions
- Catchment-scale water management - 24 mentions
- Regenerative agriculture and holistic management - 22 mentions
- Water harvesting and storage - 21 mentions
- Agroecological techniques and landscape management - 19 mentions

- Monitoring and data-driven decision-making - 17 mentions
- Nutrient management and effluent control - 15 mentions
- Diverse cropping and pasture management - 14 mentions
- Waterway management and environmental impacts - 19 mentions
- Challenges in integrating water management with farming practices - 18 mentions

Theme: Climate Change Impacts

- Climate change impacts and variability - 16 mentions

12.2.6 Section 6: Biodiversity Conservation

Section 6 Key Themes

Theme: Benefits of Biodiversity

- Biodiversity as a foundation for ecological health - 84 mentions
- Benefits of biodiversity for soil health and fertility - 82 mentions
- Ecosystem services provided by biodiversity - 64 mentions
- Economic and cultural benefits of biodiversity - 16 mentions
- Importance of biodiversity for ecosystem function and resilience - 15 mentions

Theme: Biodiversity Conservation and Farm Resilience

- Biodiversity conservation and farm resilience - 62 mentions
- Integration of biodiversity with sustainable farming practices - 52 mentions
- Challenges and complexities of biodiversity conservation - 48 mentions
- Biodiversity as a critical component of sustainable agriculture - 36 mentions
- Role of biodiversity in ecosystem balance and resilience - 21 mentions
- Complexities and trade-offs of biodiversity conservation - 14 mentions

Theme: Challenges and Barriers

- Cost and resource constraints - 46 mentions
- Lack of knowledge and awareness - 36 mentions
- Financial risks and economic pressures - 33 mentions
- Mindset and attitude shifts - 22 mentions

- Practical challenges and implementation difficulties - 22 mentions
- Environmental constraints and climate challenges - 17 mentions
- Complexity of land management decisions - 15 mentions

Theme: Support and Solutions

- Incentives and policy support - 19 mentions
- Educational and research needs - 16 mentions

12.2.7 Section 7: Perception of Legislative Frameworks

Section 7 Key Themes

Theme: Importance and Impact of Legislation:

- Resource Management Act (RMA) 1991 - 40 mentions
- Legislation and regulatory frameworks - 24 mentions
- Climate change legislation - 7 mentions
- Sustainability policies and programs - 5 mentions

Theme: Awareness and Understanding:

- Familiarity and understanding - 20 mentions

Theme: Scepticism and Concerns:

- Concerns about legislation effectiveness - 13 mentions
- Scepticism towards legislative interventions - 11 mentions

Theme: Impact on Farm Management:

- Impact on farm design and practices - 12 mentions
- Impact on profitability and economic viability - 8 mentions

Theme: Need for Holistic Approaches and Education:

- Need for holistic management approaches - 3 mentions
- Importance of education and passion - 4 mentions

Theme: Challenges and Uncertainty:

- Regulatory and bureaucratic challenges - 21 mentions
- Uncertainty and changing regulatory landscape - 9 mentions